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ROYAL SOCIETY OF MEDICINE

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J. Y. W. MacALISTER

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THE EDITORIAL COMMITTEE

VOLUME THE EIGHTH

SESSION 1914-15

PART I

OCCASIONAL LECTURES — NOTES ON NEW BOOKS

SECTION OF ANÆSTHETICS — BALNEOLOGICAL & CLIMATOLOGICAL SECTION

SECTION FOR THE STUDY OF DISEASE IN CHILDREN

CLINICAL SECTION — DERMATOLOGICAL SECTION

ELECTRO-THERAPEUTICAL SECTION

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COMPRISING THE REPORT OF THE PROCEEDINGS FOR THE SESSION 1914-15

GENERAL REPORTS

LONDON
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1915

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The Society does not hold itself in any way responsible for the statements made or the views put forward in the various papers.

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SUPPLEMENT

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NOTES ON BOOKS.

[*The purpose of these "Notes" is neither to praise nor to blame, but merely to draw attention to the new books and new editions which have been added to the Society's Library.*—Ed.]

Essentials of Physiology. By F. A. Bainbridge, M.A., M.D.Cantab., D.Sc.Lond., F.R.C.P., and J. Reworth Menzies, M.D.Edin. Illustrated. Price 10s. 6d. net, 8vo. London: Longmans, Green and Co., 1914.

The author's aim in this book has been to bring together in a concise form the fundamental facts and principles of physiology, primarily for the purpose of meeting the requirements of the medical student preparing for a Pass examination. Histological details and descriptions of chemical and experimental methods belonging to the laboratory course have been as far as possible excluded, separate text-books being available for this branch of the student's work. By this exclusion the volume has been kept of a moderate size, and has enabled the authors to devote more space to the essential object of their work. A point of some importance is the fact that the anatomical nomenclature in use in this country has been retained, while the Basle nomenclature is inserted in brackets. Until this question of terminology is definitely settled the old nomenclature may still be expected to be received with the most favour.

Syrian Anatomy, Pathology, and Therapeutics; or "The Book of Medicines." The Syriac Text, edited from a rare manuscript, with an English translation, &c., by E. A. Wallis Budge, M.A., Litt.D. Published under the direction of the Royal Society of Literature of the United Kingdom. Vol. I.: Introductory; Syriac Text. Vol. II.: English Translation and Index. Pp. (Vol. I), clxxviii + 614; (Vol. II), xxvi + 804. Price 42s. net. London: Humphrey Milford, Oxford University Press, 1913.

At some unknown date, perhaps twenty centuries ago, an earnest follower of Hippocrates, who had great faith in the usefulness of human dissection, wrote in Greek his lectures upon Human Anatomy, Pathology, and Therapeutics, and these were translated from Greek into Syriac by a Syrian physician, who was probably attached to one of the great medical schools of the East, early in the Christian era. Unfortunately the Syriac manuscript, copied for Dr. Budge at a little town on the Tigris, gives the name of neither the author nor the translator, but, thanks to the Royal Society of Literature and to Dr. Budge's translation into English, we are able to get a clear insight into the knowledge possessed by the disciples of Hippocrates. Though the lecturer's knowledge of anatomy was limited, for he confused arteries, veins, nerves, and tendons, he was well aware of the importance of the brain, which governs the senses and nerves; the heart, which governs the body and transmits

life to every part of the body; and the liver, which governs digestion and changes food into blood. He who cannot make a correct diagnosis cannot heal the disease, hints the lecturer, and he prescribes diet for the healthy as well as the sick. Moderation is preached, and he quotes with approval the saying of a philosopher, "I wonder how a man who does not over-eat himself can ever die." Bleeding, purging, emetics, enemas, fomentations, poultices, and baths are all praised. Nearly a thousand prescriptions are given, resembling those found in the Ebers Papyrus, but it is doubtful whether any of them will be adopted by Fellows of the Royal Society of Medicine. The second section of the book deals with astrology, and was probably written by a scribe who had more faith in spells and divinations than in the teaching of Hippocrates. The third and final section, with its extraordinary prescriptions, throws light upon the folk-lore of Mesopotamia. As we should expect in a scientific treatise, there is no mention from first to last about the fees of the physician, but we can guess that he may have lived in the Babylonian days, when, if a surgeon performed a serious operation upon the slave of an officer and "brought him to death," he had to replace the slave by another!

PRÉCIS DE CHIRURGIE DE GUERRE. Par EDMOND DELORME. Illustrated; pp. ii + 231. Price 4s. net, small 8vo. Paris: Masson et Cie., 1914.

Dr. Delorme tells us that he began his career during the disasters of 1870. He is now Medical Inspector-General of the French Army. This précis of military surgery was "tracé d'un jet" after "the *unexpected* declaration of this war" during long days of labour and nights devoid of ease both in Paris and at the front, no matter where. It is the outcome or development of his "Conseils au Chirurgions," which have been circulated in large numbers to surgeons both at the front and at the base. It is a manual of military surgery—a small and compendious volume, with rounded corners, evidently intended for the pocket. It deals shortly with technical subjects, such as the varieties of implements with which wounds are produced in war—cold steel, shells, bullets, &c., and also with projectiles, ballistics, and matters of that kind. It then discusses the nature of the wounds produced by instruments of war in a general way, and describes first-aid and subsequent methods of dressing. The greater part of the book is devoted to injuries of particular tissues and regions of the body, in which the peculiarities of each, the complications and treatment, are dealt with in more or less detail. Throughout, the differences between military and civil practice are emphasised. Useful tables for the recording of cases are given at the end. There are a few illustrations.

TUBERCULOSIS OF THE BONES AND JOINTS IN CHILDREN. By JOHN FRASER. Illustrated; pp. xvi + 352. Price 15s. net, large 8vo. London: A. and C. Black, 1914.

The work is divided into two parts. The first, or general, part deals with the ætiology, pathology, clinical features, diagnosis, X-ray examination, prognosis, and treatment of bone and joint tuberculosis, while in the second, or special, part tuberculous disease of individual regions affected in children is similarly discussed. A full bibliography of recent literature is appended to each section. The volume is illustrated by 51 full-page plates and 164 figures in the text, and contains a full subject and authors' index.

AN INDEX OF DIFFERENTIAL DIAGNOSIS OF MAIN SYMPTOMS. By VARIOUS WRITERS. Edited by HERBERT FRENCH, M.A., M.D.Oxon., F.R.C.P.Lond. With 16 coloured plates and 200 illustrations in the text; pp. xii + 1017. Price 21s. net, 8vo. Bristol: John Wright and Sons, Ltd., 1913.

This work has been twice reprinted since the issue of the first edition in March, 1912. It was designed to form a companion volume to the publishers' "Index of Treatment" which appeared in 1907, six editions of which have been called for. The various symptoms are arranged alphabetically in the body of the book; the general index at the end gathers these together under the names of the different diseases in which they occur. Treatment, pathology and prognosis are only dealt with so far as they bear upon differential diagnosis.

HISTORICAL SKETCHES OF OLD CHARING. THE HOSPITAL AND CHAPEL OF SAINT MARY RONCEVALL. ELEANOR OF CASTILE, QUEEN OF ENGLAND, AND THE MONUMENTS ERECTED IN HER MEMORY. By JAMES GALLOWAY, A.M., M.D., Senior Physician and a Vice-President, Charing Cross Hospital. Illustrated; pp. 82. Price 10s. 6d. net, large 8vo. London: John Bale, Sons and Danielsson, Ltd., 1914.

The first of these studies, "The Hospital and Chapel of St. Mary Roncevall," originally appeared in the History Section of the PROCEEDINGS OF THE ROYAL SOCIETY OF MEDICINE. It throws light upon a chapter of ecclesiastical history, which though well known to students of the past records of London, has never hitherto been brought into full relief. The Hospital of St. Mary Roncevall, Charing Cross, was an offshoot of the Convent of St. Mary Roncesvalles in the Pyrenees, and owed its foundation in London to the munificence of William Marshall, second Earl of Pembroke, who gave the brethren who came to seek alms in London for the mother foundation, lands and houses at Charing, and the revenues of property situate in other parts of the country. The Hospital at Charing was mainly under the domination of foreign ecclesiastics during the first half of its existence, and later it passed under the control of the English clergy, who were in conflict with their foreign colleagues for more than half a century. It was during the fifteenth century that the functions of the Hospital as a place of cure for the needy sick developed. In 1475 the Fraternity of St. Mary Roncevall was founded, but it lasted barely seventy years, as in common with similar institutions it was dissolved by Henry VIII, in 1544, and the property passed into lay hands. A calendar of the Hospital from the date of its foundation to the time of the Deed of Surrender is given.

The second study is a brief record of the well-known history of Queen Eleanor of Castile, wife of Edward I, followed by what is not well-known, namely, a detailed record, architectural and historical, of the crosses erected by Edward I to her memory. There is an engraving of the Queen's effigy, with several engravings and photographs (by the author) of the crosses.

THE CHILDREN OF THE NATION: HOW THEIR HEALTH AND VIGOUR SHOULD BE PROMOTED BY THE STATE. By the Right Hon. Sir JOHN E. GORST. Second Edition; pp. x + 297. Price 7s. 6d. net, 8vo. London: Methuen and Co., 1907.

This book is one of the earlier volumes in the "New Library of Medicine," issued by Messrs. Methuen. Apparently this new edition is a reprint of the first. Its title fully explains its theme—namely, the integral value to the State of the well-being of the nation's children. The author, following some introductory remarks pointing out the national interest in the subject, proceeds to develop his theme by dealing with such matters as infant mortality, the medical inspection of school children, underfed school children, overworked children, children's ailments, infants' schools, medical aid, and State children. The author discusses the difficulty of providing the funds necessary for initiating reforms in dealing with the nation's children.

THE BIOLOGY OF THE BLOOD CELLS, WITH A GLOSSARY OF HÆMATOLOGICAL TERMS. For the Use of Practitioners of Medicine. By O. C. GRUNER, M.D.Lond. Illustrated with coloured plates, micro-photograms and diagrams; pp. xii + 392. Price 21s. net, large 8vo. Bristol: John Wright and Sons, Ltd., 1913.

This work by Dr. O. C. Gruner, of Montreal, purports to bring up to date our knowledge of the clinical study of the blood diseases. As pointed out by the author, "Special stress has been laid upon the close relationship between changes in the blood-forming organs and the blood-picture as the clinician sees it, and also upon the minute morphology of the various blood cells, whether sessile or free-floating." Moreover, "above all, the attention of the student has been directed to the fundamental unity of design which is the basis of hæmopoiesis from birth to death throughout the animal kingdom." After some introductory remarks, the main subject-matter of the book is divided into seven chapters as follows:

(1) The Primordial Blood Cell, (2) The Red Blood Cell, (3) The Lymphocyte, (4) The Large Mononuclear Leucocyte, (5) The Neutrophile Leucocyte, (6) Certain Phlogocytes, and (7) The Cytoplastic Phenomena of Blood-forming Tissues. The progress of the science of hæmatology is shown in the book by the terminology which distinguishes it. In a glossary is explained the meaning of the terms employed, and it is not without interest to note that thirty-three pages are required for this purpose. References to the literature, an index of diseases, of authors, and of animals, respectively referred to in the volume, and a copious general index complete the work.

WINTER IN ALGIERS; WITH NOTES ON HAMMAM R'IRHA, BISKRA, AND OTHER PLACES OF INTEREST IN ALGERIA. By ALFRED S. GUBB, M.D. Ninth edition, with map and numerous illustrations in text; pp. 114. Price 2s., 8vo. London: Baillière, Tindall and Cox, 1912.

A brief description of the climate, scenery and flora of Algeria—the premier colony of France—forms the commencement of this small handbook. This is followed by fuller details of the city of Algiers, the native quarters, and the European suburb of Mustapha Supérieur. Hotel and private villa accommodation, once scanty and at monopoly prices, is now abundant. The climate of Algiers and its surroundings is good for those suffering from asthma, bronchitis, emphysema, heart and kidney disease, arteriosclerosis, gout, and rheumatism. But its most striking results are seen in the recoveries from incipient phthisis, indeed, a large proportion of the European inhabitants were formerly victims of that disease in its early stages, and are a living witness to the potency of the climate in this respect. Recovery from tuberculous laryngitis—usually a hopeless disease—has been known to result from residence in Algiers. As in the case of other resorts, pulmonary tuberculosis in its fully developed stages is not benefited, but if anything aggravated, by the Algerian climate. Hammam R'Irha, with its hotel and bathing establishment; places of interest on the road to Biskra, such as Hammam Meskoutine and El Kantara, are also described, as well as Biskra, "the desert city," now a popular health centre. A short account of Tunis and full details of the various routes to Algiers, with fares, conclude the work. The book is plentifully illustrated with photographic reproductions of scenery, antiquities, and social life in Algeria.

PUBLIC HEALTH LABORATORY WORK. By HENRY R. KENWOOD, M.B., F.R.S.Edin., D.P.H., F.C.S. Sixth edition, with illustrations; pp. xii + 418. Price 10s. net, 8vo. London: H. K. Lewis, 1914.

In this new edition the author has excluded all but occasional reference to bacteriological matters, in order to keep the volume within the compass of a handy laboratory guide to the chemical branch of public health laboratory work. His main reason for the adoption of this new policy is that the subject of bacteriology is well provided for by several excellent handbooks, from which the public health student can gain his bacteriological knowledge.

GUNSHOT INJURIES: HOW THEY ARE INFLICTED, THEIR COMPLICATIONS AND TREATMENT. (Prepared under the direction of the Surgeon-General, U.S. Army, and published by authority of the Secretary of War. By Colonel LOUIS A. LAGARDE, U.S. Army Med. Corps (Retd.). Illustrated; pp. x + 398. Price 18s. net, 8vo. London: John Bale, Sons and Danielsson, Ltd., 1914.

As the author says, he has as far as possible presented the characteristic features of wounds by the old armament in pre-antiseptic times, and compared these with the results of gunshot injuries by modern arms in the Spanish-American, Boer, Russo-Japanese, and Balkan wars. He has thus brought his account of them up to date. The work deals not only with the varieties of wounds caused by firearms of all descriptions, from toy pistols

and shot-guns to the largest howitzers, but also with such matters as projectiles, explosives, ballistics, and other very technical matters of military interest. It concludes with a chapter on the medico-legal aspects of gunshot wounds. Between these sections, which form, so to say, the cover of the book, will be found information in full detail on the nature and varieties of gunshot wounds, their complications and their treatment. The subject is dealt with from the general standpoint, and also regionally. There are a large number of illustrations. It is important to note the high authority under whose direction it has been prepared; for, as stated in the title, this treatise has been prepared under the direction of the Surgeon-General, U.S. Army, and revised in his office.

URGENT SURGERY. By FELIX LEJARS. Translated from the Seventh French Edition by WILLIAM S. DICKIE, F.R.C.S. (third English impression). Vol. I, Introductory: Head, Neck, Chest, Spine, Abdomen. Illustrated; pp. xvi + 614. Price 25s. net, 8vo. Bristol: John Wright and Sons, Ltd., 1914.

In the seventh French edition of this work by Professor Lejars are contained five additional chapters on, respectively, acute dilatation of the stomach, acute pancreatitis, obstruction of the mesenteric vessels, sigmoiditis and perisigmoiditis, and dislocations of the pelvis, while the whole work has been subjected to careful revision, and has been largely remodelled. By means of this translation Mr. Dickie has enabled English-speaking surgeons to become more closely acquainted with the surgical technique and practice of their French colleagues. There are several full-page plates, and the illustrations in the text amount almost to two on every page.

DISEASES OF THE RECTUM AND COLON, AND THEIR SURGICAL TREATMENT. By JEROME M. LYNCH, M.D. Illustrated; pp. x + 596. Price 21s. net, 8vo. Philadelphia and New York: Lea and Febiger, 1914.

This book, according to the author, has been mainly written for the benefit "of those practitioners who have not yet attained well-rounded experience in rectal and colonic surgery," and in view of this standpoint the subject is discussed "in very full detail." He points to the lack of teaching which prevails in the United States in respect of rectal surgery, emphasising this fact by stating that "there is not a university or medical college of any importance that has a recognised specialist as a professor of proctology," and he insists that the time has now come "when stool examination and proctoscopy will be known to be as important as blood examination and urinalysis." Although the book has been designed to appeal more to the practitioner than to the specialist, there is no doubt that the latter will find its pages of interest in showing the methods and experience of a well-known American proctologist. Moreover, the chapters upon the colon, such as those on colostomy and ileostomy, appendicostomy, short-circuiting, and constipation, contain matter of interest to the general surgeon. The book is profusely illustrated and has a full index.

PRACTICAL MEDICAL ELECTRICITY: A HANDBOOK FOR HOUSE SURGEONS AND PRACTITIONERS. By ALFRED C. NORMAN. Illustrated; pp. viii + 226. Price 5s. net, small 8vo. London: Scientific Press, 1914.

This book serves as a link between works on medical electricity proper and those written for the technical student, a knowledge of elementary principles not being taken for granted. The first half of the book is devoted to medical electricity, and the consideration of apparatus and technique is from the point of view of voltage, amperage, and resistance, as so many users of the X-ray are hampered by inefficient practical knowledge. The second part deals with radiography, all improvements to date receiving attention. X-ray diagnosis, the dangers of the X-ray, advanced X-ray work, such as orthodiagraphy, stereoscopic radiography, and the bismuth meal, are included, but radiotherapy is not touched upon.

THE STORY OF BETHLEHEM HOSPITAL FROM ITS FOUNDATION IN 1247. By E. G. O'DONOGHUE, Chaplain to the Hospital. Illustrated; pp. xx + 427. Price 15s. net, 8vo. London: T. Fisher Unwin, 1914.

This is the first complete history of this institution, and all the archives as far as 1850 have been placed at the disposal of the author. The Priory of St. Mary of Bethlehem was founded in Bishopsgate Without, on the present site of Liverpool Street Station, on October 23, 1247. It was a daughter house of the house of the Basilica of the Nativity, built in Bethlehem, Palestine, by the Emperor Constantine, A.D. 330. The work of the Hospital as an asylum was begun in 1337, when six lunatics were removed there from the "Stone House," which stood on the site now occupied by the National Gallery, land which at that time was the property of Bethlehem. Although in 1346 the House and Order of Bethlehem were taken under the patronage and protection of the City, Bethlehem was seized by the Crown on more than one occasion during the fourteenth century as an "alien Hospital." The Crown continued to appoint Masters, including John Arundell, Physician and Chaplain to Henry VI, and George Boleyn, brother of Anne, until Henry VIII in 1540 grudgingly granted Bethlehem with St. Bartholomew's Hospital to the City. The Great Fire spared the Hospital, but by 1674 it had become so ruinous that it was abandoned. A new site was found at Moorfields, now represented by Finsbury Circus, and here in 1676 was opened the "Palace magnificently built," designed by Robert Hooke, the scientist. This was the "Bedlam" of Hogarth and the Georgian days. Unfortunately, Hooke's Palace rested on insecure foundations, being built on the City moat, and by 1800 it had fallen into such disrepair that a third removal became necessary. The present building in St. George's Fields, Southwark, was begun in 1812, and opened in 1815. The book is copiously illustrated, and contains full information concerning the inmates, sane and insane, of Bethlehem Hospital, and the vicissitudes of fortune which it has undergone during its six centuries of existence.

LEAD POISONING: FROM THE INDUSTRIAL, MEDICAL, AND SOCIAL POINTS OF VIEW. Lectures delivered at the Royal Institute of Public Health. By Sir THOMAS OLIVER, M.A., M.D., F.R.C.P. Pp. x + 294. Price 5s. net, small 8vo. London: H. K. Lewis, 1914.

In publishing his lectures on "lead poisoning" in book form, the author has rendered his contributions upon the subject more accessible. The work shows how valuable State interference can become when directed towards safeguarding the public health, in respect to industrial processes which are harmful. By means of the Home Office regulations and inspections much has been accomplished to lessen the evil effects to which workers in lead are exposed; and good as the past has been in this regard, the author maintains that better results may still be expected. From the medical aspect a full description is given of plumbism and of how to deal with it; of its protean forms, and of the necessary methods of prevention. In an appendix is published, by permission of the Controller of H.M. Stationery Office, the factory and workship orders relating to lead poisoning.

CLINICAL EXAMINATION OF THE BLOOD AND ITS TECHNIQUE: A MANUAL FOR STUDENTS AND PRACTITIONERS. By Professor A. PAPPENHEIM (Berlin). Translated and adapted from the German by R. DONALDSON, M.A., M.B., Ch.B., F.R.C.S.Ed., D.P.H. Pp. x + 87. Price 3s. 6d. net, small 8vo. Bristol: John Wright and Sons, Ltd., 1914.

This small book has been designed by the author to serve as an elementary guide to the clinical examination of the blood. For this purpose a simple technique is provided, controversial matter is excluded, and only absolutely essential details, of first importance, dealt with. The division of the text into three parts shows the scope of the volume—namely, (1) the blood film, inclusive of the method and technique of staining, the microscopic examination of and the differential diagnosis of the most important blood changes as seen in stained blood films; (2) hæmocytometry; and (3) hæmoglobinometry. The staining method recommended is May-Grünwald's solution, eosin-methylene blue, dissolved in methyl

alcohol, followed by Giemsa's glycerine-alcoholic solution of the Romanowsky stain, known as Giemsa's new formula. The cell types described have been taken from the author's "Atlas der menschlichen Blutzellen." Two coloured plates showing the chief cell forms likely to be met with precede the text.

QUAIN'S ANATOMY. Edited by Sir E. A. SCHÄFER, J. SYMINGTON, and T. H. BRYCE. Eleventh Edition. Vol. II, Part II, "Splanchnology," by J. SYMINGTON. Illustrated; pp. x + 392. Price 10s. 6d. net, 8vo. London: Longmans, Green and Co., 1914.

The present volume almost completes the eleventh edition of this well-known work on anatomy. There remains only the part which is concerned with the bones, ligaments, and muscles, upon which Professor Bryce is engaged, and which we understand will appear before long. The portions which have already appeared deal respectively with Morphology, Microscopic Anatomy, and Neurology, and each one forms a complete text-book of the particular subject with which it is concerned. The present part includes the topographical anatomy and morphology of the digestive, respiratory and genito-urinary systems, as well as the ductless glands and organs of internal secretion. There are a large number of original illustrations as well as skiagrams of the teeth.

ABDOMINAL SURGERY: CLINICAL LECTURES FOR STUDENTS AND PHYSICIANS. By THORKILD ROVSING. Edited by PAUL MONROE PILCHER, M.D. Illustrated; pp. xii + 477. Price 21s. net, 8vo. Philadelphia: Lippincott Co., 1914.

This volume, as indicated by its title, contains a series of clinical lectures delivered by the Professor of Clinical Surgery in the University of Copenhagen, translated into English and edited. They are essentially clinical, each lecture having reference to an individual case, or group of cases, shown to the students; in many instances the results of surgical treatment, both in regard to the diagnosis and the relief of symptoms, are added. As will be evident from the following headings of lectures, the book includes more *and* less than the title "Abdominal Surgery" suggests. Lecture I is upon "The Basis and Principles of Clinical Surgery." Lectures II and III deal with "Antiseptic Methods." Lectures IV and V are upon "Anæsthetics, General and Local." Part of Lecture VI, and the whole of Lectures VII and VIII concern structures which do not strictly fall under the heading "Abdominal." Lecture VI is headed "Foreign Substances contained in the Œsophagus, the Stomach and Intestines." Lecture VII is upon "Stricture of the Œsophagus," and Lecture VIII upon "Dilatation of the Œsophagus." Lectures IX to XXV deal chiefly with the "Surgical Treatment of Diseases of the Stomach." The subject of "Ulcer of the Stomach" is very fully considered, no fewer than seven lectures being devoted to it. Lecture XXI deals with "Cancer of the Stomach." Lecture XXII is entitled "Peptic Ulcer of the Jejunum: Technique of Gastro-enterostomy"; the author deals fully with several of the numerous methods by which this operation has been accomplished, drawing attention to some of the objections which he personally feels to these procedures. He concludes this Lecture by giving an account of the technique which he now employs. The last three lectures are devoted to Diseases of the Liver, including "Echinococcus Cysts, Abscess, and Chronic Jaundice." The remaining abdominal organs are not included in the series. The volume contains a large number of illustrations, and is furnished with an index.

THE HEART IN EARLY LIFE. By G. A. SUTHERLAND, M.D., F.R.C.P. Pp. xvi + 211. Price 6s. net, small 8vo. London: Henry Frowde and Hodder and Stoughton, 1914.

This book "deals with the clinical problems of cardiac disturbances and diseases during childhood and youth as they present themselves in the ordinary routine of practice." Within recent years many advances have been made in the elucidation of the problems of cardiac pathology in adult life, and an attempt is here made to apply the same methods of investigation during childhood and youth. In the first section are described the various

functional disturbances, and amongst these irregularities of action occupy a prominent place, and their analysis by means of polygraphic tracings is fully considered. The majority of the forms of functional disturbance, such as rapid action, slow action, dilatation, and various subjective phenomena, are traced to a nervous origin outside the heart, rather than to any intrinsic weakness of the heart. The next section deals with the borderland between functional disturbance and organic disease, in which is placed a condition like paroxysmal tachycardia arising in an apparently healthy heart, but leading eventually to all the signs of complete cardiac failure. The third section deals with organic heart disease, and the outstanding influence of rheumatic infection in its production is emphasised. In childhood it is the active and developing lesions which fail to be considered as contrasted with the effects of past carditis and of chronic degenerative changes in adult life. The nature and significance of the cardiac signs and symptoms are discussed, and the prognosis and treatment are to be determined by a careful consideration of these signs and symptoms rather than from any objective evidences of the existence of valvular lesions.

NOTES ON DENTAL SURGERY AND PATHOLOGY. By T. W. WIDDOWSON, L.D.S.(R.C.S.Eng.). (Interleaved with blank pages for the reader's own notes and drawings.) Illustrated; pp. xi + 345. Price 10s. 6d., 8vo. London: John Bale, Sons and Danielsson, Ltd., 1914.

This book, while intended primarily for the use of students preparing for examination, is also designed to serve as a work of reference for the practitioner. The author states that "the notes are a combination of his own observations and practical experience with a compilation from the standard works on dental surgery." The field of dental surgery and pathology is dealt with. Details of operative procedure are for the most part omitted. The subject of dental caries is discussed at length, especially from the histological and bacteriological standpoint. The varieties of fractures of the jaws are mentioned in some detail, together with a description of the different forms of splints, accompanied by illustrations of each. Throughout the book most of the illustrations are diagrammatic which the author considers the best for teaching purposes, and it is intended that the reader should add his own notes and sketches, for which purpose blank pages are interleaved. There is a full index to the volume.

ON PHARMACO-THERAPY AND PREVENTIVE INOCULATION, APPLIED TO PNEUMONIA IN THE AFRICAN NATIVE, WITH A DISCOURSE ON THE LOGICAL METHODS WHICH OUGHT TO BE EMPLOYED IN THE EVALUATION OF THERAPEUTIC AGENTS. By Sir ALMROTH E. WRIGHT, F.R.S. Price 4s. 6d. net, 8vo. London: Constable and Co., 1914.

This book consists of a report to the Witwatersrand Native Labour Association upon researches made under their auspices upon the treatment and prevention of pneumonia among African natives. The researches were of two kinds. In one is studied the influence of the drug introduced by Morgenroth—viz., ethylhydrocapreinhydrochlorate. Its effect upon the pneumococcus *in vitro* is compared with that of other antiseptics; the bactericidal effects of the blood serum of mice treated with the drug is compared with the effects of the serum of untreated mice; and the bactericidal and opsonic effects of the blood serum of normal and of pneumonic natives after the ingestion of the drug are compared with similar effects of blood serum drawn off before such treatment. The second part of the report is devoted to the study of (*a*) the treatment and (*b*) the prevention of pneumonia by inoculation with pneumococcic vaccines. In the latter research several thousand natives in various mines received protective inoculations, but every other man presenting himself was left uninoculated, so that a complete system of controls was established. The subsequent incidence of pneumonia, and the number of fatal cases in the two groups, were carefully noted. There is also a full discussion of the relative values of the statistical method, and of what the author calls the experimental method, in researches of this kind.

Proceedings of the Royal Society of Medicine.

SUPPLEMENT

(Vol. VIII, No. 2, December, 1914).

NOTES ON BOOKS.

[*The purpose of these "Notes" is neither to praise nor to blame, but merely to draw attention to some of the new books and new editions which have been added to the Society's Library.*—Ed.]

Physiologie normale et pathologique des reins (Clinique des voies urinaires, Hôpital Necker). Par L. Ambard. Diagrams and Illustrations; pp. iv + 332. Price 15 fr. Paris: F. Gittler, 1914.

A highly technical work representing the result of the author's researches at the Hôpital Necker in Paris, where he is the Chief of the Chemical Laboratory of the Urinary Clinic. He claims to have proved that the excretion of urea by the kidneys follows a rigorously mathematical formula, by departure from which he is enabled (by frequent analyses, thus avoiding the pitfalls spread by such fortuitous occurrences as the drinking of large quantities of liquid or increased diaphoresis from various causes) to estimate the degrees of functional activity of the kidneys. The author's method has been practised at the Hôpital Necker for the past three years, and it is claimed for it that it has proved itself superior to all others for diagnostic purposes.

L'Appendicite, étude clinique et critique. Par Léon Bérard et Paul Vignard. Illustrated; pp. xii + 878. Price 18 francs. Paris: Masson et Cie., 1914.

The preface contains a brief historical and bibliographical survey of this subject, from which it appears that so long ago as 1759 a French surgeon, Mestivier, published an account of a case of appendicitis in the *Journal de Médecine, Chirurgie, et Pharmacie*, though probably in some measure out of deference to the traditional respect paid to the opinion of Dupuytren, who would not admit the relationship between perityphlitis and appendicitis, this relationship continued to be denied by all but the few until the publication of the researches of Fitz, of Boston, in 1886. In 1827 Melier, writing of diseases of the appendix, had said that, if it were possible to establish a certain diagnosis of such a lesion, one might conceive the possibility of being able to obtain relief by operative measures, though, considering the then dangers of surgical interference, the suggestion was not unreasonably disregarded. For a more detailed bibliography of the subject the reader is referred to the index annexed to

the treatise by Sprengel (Stuttgart, 1906). The work is divided into ten parts, embracing the anatomy and pathology of the appendix and neighbouring structures, and the clinical symptoms and complications of appendicitis, which latter are studied here at greater length, inasmuch as they are said to be somewhat neglected by other writers. The question of treatment is discussed in the light of the latest information derived from articles in the press and the transactions of the various medical societies and congresses. The work is embellished with 158 illustrations.

THE WHOLE ART OF BANDAGING. By THEKLA BOWSER, with an Introduction by JAMES CANTLIE, M.A., M.B., F.R.C.S. Illustrated; pp. xii + 108. Price 1s. net, small 8vo. London: John Bale, Sons and Danielsson, Ltd., 1914.

This booklet, intended for those who are learning the art of bandaging, describes the various uses to which the triangular and other bandages can be put, and is full of hints for emergencies. The author, for many years a nursing sister of the St. John Ambulance, claims that she has been enabled, by her experience in teaching bandaging, to detect and explain away some of those difficulties which her own pupils, and probably many others, are liable to encounter.

GAS POISONING IN MINING AND OTHER INDUSTRIES. By JOHN GLAISTER, M.D.Glas., D.P.H., Professor of Forensic Medicine and Public Health in the University of Glasgow, Senior Medico-legal Examiner in Crown Cases for Glasgow and Lanarkshire, and DAVID D. LOGAN, M.D.Glas., D.P.H., Surgeon to the Coltness Ironworks, Newmains. Illustrated; pp. xii + 471. Price 10s. 6d. net. Edinburgh: E. and S. Livingstone, 1914.

It has been said that while the nineteenth century was the era of the steam engine, the twentieth will be that of the gas engine; and with the extended use of gas in industrial occupations it is a fact that the number of victims of carbon monoxide poisoning already shows a decided increase. In these days of compensation for accidents, the subject of gas poisoning has assumed additional importance, yet there are few medical men who are competent from their own knowledge of this subject to testify as experts in medico-legal cases. The authors, each of whom from his own standpoint has had considerable experience of this speciality, attempt in this volume to focus within reasonable limits the present knowledge of the subject, which has met with comparatively scanty literary attention in this country. This compendium is intended to help practitioners of law as well as of medicine, and the more so since it includes a bibliography—mostly of Reports of Commissions and articles contributed to periodicals—extending over twelve pages.

ELEMENTS OF SURGICAL DIAGNOSIS. By Sir ALFRED PEARCE GOULD, K.C.V.O., M.S.Lond., F.R.C.S.Eng. Fourth Edition, revised and enlarged by the author with the assistance of ERIC PEARCE GOULD, M.A., M.Ch.Oxon., F.R.C.S.Eng. Illustrated; pp. xiv + 723. Price 10s. 6d., small 8vo. London: Cassell, 1914.

Sir Alfred Pearce Gould's well-known "Elements of Surgical Diagnosis" now appears in a fourth edition. In the revision of it he has been assisted by his son. Some new illustrations and plates of skiagrams have been added, and it has been brought completely up to date. This has necessitated an entire re-setting, and a greater variety of type has been used in order to facilitate reference. The arrangement of the matter is first general and then regional. The aim of this book is to enable the student or practitioner to approach any particular case from a scientific point of view and to prevent the reader from falling into any of those pitfalls that are caused by imperfect observations or unjustified generalisations.

FLIES IN RELATION TO DISEASE: NON-BLOODSUCKING FLIES. (Cambridge Public Health Series.) By G. S. GRAHAM-SMITH, M.D. Illustrated; pp. xvi + 389. Price 12s. 6d. net, 8vo. Cambridge: Cambridge University Press, 1914.

This book is intended to appeal to many classes of readers, entomologists, housewives, the man in the street, and above all to doctors. It gives information to all these classes, and, by a suitable arrangement of type, enables those who are unconcerned with technicalities to pass on to the next subject of general interest without anxiety as to having missed any vital point. The dangerous characteristics of the non-suctorial flies have received but scanty attention from the medical profession, perhaps because the iniquities of their suctorial cousins have been so prominently brought forward. The author presents a full account of the anatomy and physiology of the "Busy, curious, thirsty Fly," the friend of poets and the hero of nursery rhymes. The reader will learn all that is to be known about its humble, not to say degraded and filthy origin, and the really appalling fact that a well-fed domestic fly will deposit 224 times in twenty-two hours, the deposit being 179 times what the author calls "vomit," and 45 times fæces. He will also learn about the favourite promenades for the hairy-legged fly, ranging from the foullest human excreta and garbage of all kinds to our own foodstuffs, and will have brought before him strong evidence that non-suctorial flies are important agents in transmitting typhoid, summer diarrhœa, cholera, and many other diseases. If the poet had known he would never have written, "Freely welcome to my cup, could'st thou sip and sip it up." The author prophesies that we shall some day be aroused from our extraordinary supineness with regard to these enemies in our midst and attack them with method and vigour. He discusses fully what methods may be adopted, and describes the manner in which Nature attempts to limit their number by means of various parasitic diseases. The book concludes with twenty-four pages of bibliography.

MANUEL DE CYSTOSCOPIE. Préface par le Professeur F. LEGUEU (Clinique des voies urinaires, Hôpital Necker). Par E. PAPIN. Illustrated; pp. vi + 327. Price 15 fr. Paris: F. Gittler, 1914.

This is a manual of cystoscopy giving full details of the practical technique of that operation, but purposely omitting all considerations of the conditions and symptoms which make such measures necessary. It represents the course of elementary instruction given to students (there is a secondary and more advanced course) at the Hôpital Necker, in Paris, by the author, who is the chief of the Urinary Clinic. After describing the various forms of cystoscope and other necessary instruments and appliances, illustrations and photographs are given of the normal appearances and various pathological changes to be looked for in making the examination. Attention is then directed to the ureters and the method of ureteral catheterisation, followed by an explanation of the points to be derived from examination of the urine thus obtained. This is essentially a guide to the use of the cystoscope, and it is somewhat surprising to read in the introduction that it is the only work of its kind in the French language.

PRACTICAL NURSING: A TEXT-BOOK FOR NURSES. By ANNA C. MAXWELL and AMY E. POPE. Third edition. Illustrated; pp. xvi + 864. Price 7s. 6d. net. New York and London: G. P. Putnam's Sons, 1914.

A text-book of practical nursing for nurses by nurses, containing descriptions of the ordinary routine of bed-making, care and cleansing of the patient, and the more technical duties of administering baths, douches, and enemata; of catheterisation, lavage, gavage, and nasal feeding, the application of local medicaments and giving of medicines, and the preparation of patients for the various operations. There are also directions for bandaging and dressing wounds, and hints for the ordinary emergencies. Rather more ambitious in intention are the chapters on "Bacteriology," "The Symptoms and Practical Signs of Disease," and "A Synopsis of some of the more Important Diseases." There is also a short account of "Food and Infant Feeding," and six pages upon massage. An index is mentioned as among the contents, but finds no place in the volume.

A Text-book of Insanity and other Mental Diseases. By Charles A. Mercier, M.D., F.R.C.P. Second edition. Pp. xx + 348. Price 7s. 6d. net. London: G. Allen and Unwin, Ltd., 1914.

This is the second edition of a work, published twelve years ago, which was primarily intended for the use of students of medicine as an introduction to the study of insanity, to give them a general notion of the subject without going into much detail, and incidentally to be of use to them in examinations. We are told in the Preface that the first edition had become the text-book in use in most of the universities. This enlarged edition, while still retaining its former purpose, is intended also for those, now much increased in number, who devote themselves temporarily or permanently to the special study of insanity. The bulk of the work consists of Part II, which embraces "The Forms, Types, and Kinds of Insanity," extending to just over 200 pages. There is no index.

The Salvarsan Treatment of Syphilis in Private Practice, with some Account of the Modern Methods of Diagnosis. By G. Stopford-Taylor and R. W. McKenna. Illustrated; pp. 92. Price 5s. net, 8vo. London: W. Heinemann, 1914.

This gives a résumé of the conditions for which salvarsan should be administered, and points out fully all the practical details which should be attended to in its administration. The book commences with instructions as to the best practical way of demonstrating the presence of spirochætes in syphilitic patients. For the Wassermann reaction they employ Fleming's modification of the reaction, using an alcoholic extract of guinea-pig's heart as an antigen, and note that the reaction may also occur in patients with leprosy or scarlet fever, and also shortly after an anæsthetic; as well as by syphilitics. They are strongly in favour of the intravenous method of administering salvarsan, and describe all the technical details to be attended to. All reference to neo-salvarsan is omitted; yet this drug has the advantage not only of being less toxic, but it can also be injected into the veins in a small quantity of saline without any elaborate preparations. They have found it necessary to deny the salvarsan treatment to only three patients out of 400. It is Ehrlich's opinion that there is no case yet on record in which a fatal issue can fairly be attributed to the use of salvarsan alone. The authors are of opinion that its use should always be combined with a weekly injection of grey oil for ten or twelve weeks.

Dreams. By Henri Bergson; translated, with an Introduction, by Edwin E. Slosson. Second Impression. Pp. 62. Price 2s. 6d. net. London: Fisher Unwin, 1914.

The theory advanced by the author is, in brief, that all dreams arise from stimulation of the special sense organs, and those of peripheral and visceral sensibility. But "the formative power of the materials furnished to the dream by the different senses, the power which converts into precise, determined objects the vague and indistinct sensations that the dreamer receives from his eyes, his ears, and the whole surface and interior of his body, is the memory." "The mechanism of the dream is the same as that of normal perception." In the waking state, when we perceive a real object, we merely see a sketch of it . . . which appeals to the complete memory, and this which by itself was either unconscious or simply in the thought state profits by the occasion to come out. In the waking state the memories aroused by a perception are always closely associated with our present situation, our present occupation, our present action. But in dreams we become *disinterested* in the present situation, in the present action—in short, in all which previously has guided memory. The result of a sensory stimulus during sleep is a crowd of phantom memories which aspire to fill themselves with colour, with sonority—in short, with materiality. "But the only ones that succeed are those which can assimilate themselves with the colour-dust that we perceive, the external and internal sensations that we catch, &c., and which, besides, respond to the effective tone of our general sensibility." "When this union is effected between the memory

and the sensation we have a dream." Dreams are incoherent because a peripheral sensation may excite very different memories which suit the same sensation. For instance, there may be in the field of vision a green spot with white points. This may suggest a lawn spangled with white flowers, or a billiard-table, or a host of other things. These different memory images, all capable of utilising the same sensation, chase after it. Sometimes they attain it one after the other, and so the billiard table becomes a lawn, and we watch these extra-ordinary transformations. The law that regulates the reappearance of memories in profound slumber may be very different. We know almost nothing of this profound slumber. The dreams that fill it are, as a general rule, the dreams which we forget. It is upon this profound slumber that psychology ought to direct its efforts, not only to study the mechanism of unconscious memory, but to examine the more mysterious phenomena which are raised by "psychical research." If telepathy influences our dreams, it is quite likely that in this profound slumber it would have the greatest chance to manifest itself. We have attempted very briefly to sketch the main points of the author's thesis, but for his argument we must refer readers to the book itself.

CHEMISTRY AND ITS BORDERLAND. By ALFRED W. STEWART, D.Sc. With 11 illustrations and 2 plates; pp. x + 314. Price 5s. net. London: Longmans, Green and Co., 1914.

This is an account of some of the recent developments in chemistry, written in simple language, and free from chemical symbols, for non-technical readers. The book may be divided into four sections: In the first (Chapters I-III) an attempt has been made to show how chemistry has internally split into various subdivisions, while, simultaneously, it has expanded into other fields, and has lent the aid of its methods to other sciences and to industry. The second section (Chapters IV-VII) contains explanations of various chemical subjects (*inter alia*, the colloids and the spectroscope), each of which has developed on more or less independent lines. The next section (Chapters VIII-XII) deals with radium, niton, transmutation, and the various problems of the structure of matter. The final section (Chapters XIII-XV) is intended to give some insight into the methods and organisation of modern research work, both on the technical and the human side; and a few selected instances are given of investigations which at first sight appeared to be of merely academic interest, but which have actually laid the foundations of far-extending industries which provide employment for thousands of workers.

THE PROGRESS OF SCIENTIFIC CHEMISTRY IN OUR OWN TIMES, WITH BIOGRAPHICAL NOTICES. By Sir WILLIAM A. TILDEN, F.R.S. Second Edition. Pp. xii + 366. Price 7s. 6d. net. London: Longmans, Green and Co., 1913.

This is the second edition of a work originally intended to give to students and general readers a clear statement of the successive steps which have led to the system of theory generally accepted by chemists at the present day. Preserving the fundamental idea of the earlier edition, it commences with a period coincident with the accession of Queen Victoria, when Liebig's teaching was beginning to be felt; though in a cursory introductory survey one is reminded that scientific chemistry dates back to Robert Boyle (1627-1691), before whose time what was then called chemistry or alchemy was but a confused mass of observations, largely erroneous, and of hypotheses, mainly groundless, the two principal objects of inquiry being the production of gold and the elixir of life. In 1837 Liebig was at the height of his fame, having already inaugurated the systematisation of organic chemistry, which thus for the first time came to be regarded as "the chemistry of compound radicals." There is a chapter on radio-activity, and a chronological table of important events in the history of chemical progress.

OUTLINES OF ZOOLOGY. By J. ARTHUR THOMSON, M.A., LL.D. Sixth Edition, Revised. 424 illustrations; pp. xxii + 855. Price 12s. 6d. net. Edinburgh and London: Henry Frowde and Hodder and Stoughton, 1914.

This is the sixth edition of a work intended for the use of students of zoology in the lecture room, museum, and laboratory. The first part contains chapters on Physiology, Morphology, Embryology, and Palæontology; following which the main part of the volume is devoted to a description of the Invertebrates and Vertebrates; and the two concluding chapters to the Geographical Distribution of Animals and the Theory of Evolution. There is an earlier résumé of the Doctrine of Descent, and a final appendix containing a bibliographical survey of works on the various branches of zoology mentioned above. It is copiously illustrated.

PSYCHO-PATHOLOGY OF EVERYDAY LIFE. By Professor Dr. SIGISMUND FREUD, LL.D. Authorized English Translation, with Introduction, by A. A. BRILL, Ph.B., M.D. Pp. 342. Price 12s. 6d. net. London: Fisher Unwin, 1914.

This volume is a translation of the fourth German edition of Professor Freud's well-known work. The translator, Dr. A. A. Brill, Chief of the Clinic of Psychiatry, Columbia University, who has recently published a translation of "The Interpretation of Dreams" by the same author, reminds us in his preface that Professor Freud, while tracing back from the abnormal to the normal state of mind, found "how faint the line of demarcation was between the normal and neurotic person, and that the psycho-pathologic mechanisms so glaringly observed in the psycho-neuroses and psychoses could usually be demonstrated in a lesser degree in normal persons." The psycho-pathology of everyday life is a study of the common faulty actions of daily experience, such as the forgetting of names and the order of words, the mistakes in speech, reading and writing, erroneously carried out actions, and forgetting of impressions and resolutions. Other chapters deal with Errors, Determinism, and Superstitious Beliefs. This study is complementary to Freud's other works, and in its observation of the complex problems of human nature, claims to demonstrate the link between normal and abnormal mental states. There are numerous interesting cases and anecdotes in this book. Some of these have been introduced by the translator in place of the original cases which linguistic difficulties would have rendered incomprehensible to English readers. It is worth noting, in view of much criticism that has been levelled against Freud's work, that he himself makes no claim that the *forgetting*—e.g., of proper names—may not be of a simple nature, or that it necessarily carries with it an indication of unconscious mental processes. On the other hand, Freud gives strong grounds, in this work, for his belief that most instances of faulty memory and action are "motivated" by the mechanism of repression.

THE CURVES OF LIFE; BEING AN ACCOUNT OF SPIRAL FORMATIONS AND THEIR APPLICATION TO GROWTH IN NATURE, TO SCIENCE AND TO ART; WITH SPECIAL REFERENCE TO THE MANUSCRIPTS OF LEONARDO DA VINCI. By THEODORE ANDREA COOK, M.A., F.S.A. Pp. xxx + 419. Price 12s. 6d. net. London: Constable and Co., 1914.

This work is a vast accumulation of records of what the author calls spirality, that is, the occurrence of spiral formations in Nature and Art, illustrated by a certain amount of geometrical and mathematical references. It is an inexhaustible subject, and one in which, as might be anticipated, generalisation cannot go hand in hand with observation. Very special reference is made to Art, and above all to the manuscripts of Leonardo da Vinci. Excluding occasional references to spiral-shaped micro-organisms, the part that concerns the medical profession is included in one short chapter, the thirteenth, the heading of which is as follows: "Natural objects do not consciously produce spirals—Deviation from mechanical accuracy—Spiral formation of upper end of thigh-bone—Growth and change—Corresponding structures in birds and mammals—Conical spiral of cochlea—Spiral formations: Umbilical cord, skin, muscular fibres of heart, tendo Achillis, the humerus (torsion), ribs, joints, wings and feathers, eggs, animalculæ." There are several plates and numerous illustrations in the text.

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SUPPLEMENT

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The Lettsomian Lectures on Dysentery. Delivered before the Medical Society of London, 1914. By F. M. Sandwith, M.D., F.R.C.P. Pp. 72. London: *The Lancet*, 1914.

These three lectures deal with the history of dysentery, and give a practical account of the present state of our knowledge as to its pathology and treatment. In the historical portion the marked association of the disease with famines and wars is well brought out. In the American Civil War there were 37,794 deaths from dysentery and diarrhœa, a mortality of nearly 30 per cent. of total deaths, and in the South African War there were 38,108 cases with 1,342 deaths—i.e., 3·5 per cent. It is only in the last twenty years that it has been generally admitted that dysentery is a water-borne disease. It is now recognised that the *endemic* type of disease is associated with the *Entamœba histolytica*, and that this is the form which gives rise to hepatic abscesses. The clinical and experimental evidence of this is fully set out. The history is given of the various treatments which have been advocated from time to time, including the original use of ipecacuanha, later followed by the use of the de-emetised drug, and, finally, last year the proof by Sir Leonard Rogers of the extraordinary value of emetine hydrochloride as a curative agent. The *epidemic*, which is the type that is usually met with in wars, famine, and asylums, is bacillary in origin, Shiga's bacillus being a common cause; the clinical distinction of this form from the amœbic type is still obscure, and the efficacy of emetine in its treatment is much less marked. Such cases do better with magnesium sulphate, sulphur, cyllin, and antidysenteric serum. The author lays great stress on the spread of infection by carriers—i.e., people in perfect health who yet are passing fæces infected with dysentery. He refers to several cases where such patients, especially when their duties led them to handle food, had infected several members in a household. The danger of flies in spreading infection is now well recognised; still by far the commonest medium of infection is soiled fingers.

A Treatise on Diseases of the Rectum and Anus. By A. B. Cooke, A.M., M.D. Pp. xvi + 619. Price 23s. 6d. net. Philadelphia: F. A. Davis Company; London: Stanley Phillips, 23, Creighton Road, Queen's Park, N.W., 1914.

The first sixteen chapters, embracing the more ordinary and less severe diseases of the anus and rectum, were written about twenty years ago by Dr. Cooke, who, having revised them recently, assumed the editorship of this treatise. The remaining half of the volume

is supplied by various contributors, each of whom is responsible for his section of what, in the whole, forms a system of proctology. It is claimed that the result represents the most authoritative teaching upon the subject, and the work contains numerous illustrations. Chapter XXI ("Extirpation of the Rectum") is prefaced by a brief historical résumé of the evolution of this operation.

MEDICAL DIAGNOSIS. By ARTHUR LATHAM, M.A., M.D.Oxon., F.R.C.P.Lond., and JAMES TORRENS, M.B., B.S.Lond., M.R.C.P.Lond. Illustrated; pp. xii + 641. Price 15s. net. London: J. and A. Churchill, 1915.

In the preface we are informed that there have been repeated requests from both students and practitioners for a book which contains, in concise and accessible form, the clinical information, together with the more ordinary laboratory details necessary for the purpose of making a scientific diagnosis in medical cases. And, since the information it contains is equally complete, simple in arrangement, and easily referred to, this volume appears adequately to supply the predicated want. As a good specimen of the method which has been adopted by the authors may be instanced the article upon anthrax, the symptoms of the three varieties of which, tabulated as (1) malignant pustule, acquired by inoculation, (2) wool-sorter's disease, acquired by inhalation, and (3) splenic fever, acquired by ingestion, are separately described; to which are added an explanation of the differential diagnosis between the two latter forms, and suggestions for the examination of the blood and urine for the bacillus, a photographic illustration of which is given. The whole article, illustration included, occupies less than two pages, an example of the concise precision which characterises the authors' scheme. The volume embraces the whole practice of medicine in a little over 600 pages, commencing with the specific infective and tropical diseases, and proceeding to diseases of the blood, the cardio-vascular system, the respiratory and alimentary tracts, the nervous system, and finally to those of the skin. The work is replete with bacteriological photomicrographs, cardiograms, temperature charts, and plates of urinary deposits; while the localisation of the functions of the brain and spinal cord is made clear by means of several original and instructive diagrams which form a valuable addition to the letterpress. There is a useful index.

SCIENCE AND RELIGION. By Seven Men of Science: Sir OLIVER LODGE, Professor J. A. FLEMING, Professor W. B. BOTTOMLEY, Professor EDWARD HULL, Dr. J. A. HARKER, Professor SIMS WOODHEAD, Professor SILVANUS THOMPSON. Portraits. Price 1s. net. London: W. A. Hammond, 1914.

The views of seven representative men of science are contained in this little volume, where one may read, in concise and easily understood language, the convictions of some of the leaders of modern scientific thought. Professors of geology, biology, psychology, and electricity, one and all subscribe to the declaration that the materialism of Haeckel and the agnosticism of Huxley have been abandoned by them; and that the physical energy of matter, the vital energy of organic life, and the psychical energy of the intellect are to be regarded as the products of Evolution, emanating from that "infinite and eternal energy, from which," according to Spencer, "all things proceed," and leading (perchance) to a greater perfection of mind and matter in the ages to come. This last stage of evolution, not yet within the compass of science, is that of spiritual energy, spiritual vitality, the survival of existence, immortality. "I tell you," says Sir Oliver Lodge, "with all the strength of conviction I can muster, that we do persist (after death); that people still take an interest in what is going on, that they still help us, that they know far more about things than we do, and that they are able from time to time to communicate" (page 25). "My conclusion is that survival of existence is scientifically provable by careful scientific investigation" (page 27).

LECTURES ON HOUSING. The Warburton Lectures for 1914. By B. SEEBOHM ROWNTREE and A. C. PIGOU. Pp. 70. Price 1s. 6d. net, 8vo. Manchester: University Press, 1914.

These lectures were delivered under the provisions of the Warburton Trust at Manchester; that by Mr. Rowntree on November 27, 1913, and that by Professor Pigou on January 19, 1914. The former deals very fully with the housing problem, and as measures for solving it advocates the expansion of the minimum wage policy, the decasualisation of labour, the compulsion of town planning, with a restriction on the number of houses per acre, the provision of adequate transit facilities in all towns, and making it the statutory duty of all towns to see that their inhabitants are satisfactorily housed. Professor Pigou discusses the question from the aspect that it is the duty of a civilised state to lay down certain minimum conditions in every department of life, below which it refuses to allow any of its free citizens to fall.

PHYSICS: AN ELEMENTARY TEXT-BOOK FOR UNIVERSITY CLASSES. By C. G. KNOTT, D.Sc.Edin., F.R.S.E. Third edition. Pp. 370. Price 7s. 6d. net, small 8vo. London and Edinburgh: W. and R. Chambers, Ltd., 1913.

In this new edition the work has been carefully revised and has been amplified, a new chapter having been added on the electron theory and radio-activity. In other lines of physical research, also, recent advances are dealt with.

DENTAL MICROSCOPY. By A. HOPEWELL-SMITH, L.R.C.P.Lond., M.R.C.S.Eng., L.D.S.Eng. Third edition, revised and enlarged. Illustrated; pp. xxxiv + 216. Price 15s. net. London: John Bale, Sons and Danielsson, Ltd., 1914.

The third edition of this handbook remains substantially the same as the previous one, the author considering that "the Art and Science of Dental Microscopy has not advanced very greatly during the last fifteen years." The chapter on staining has been considerably enlarged to include the recent methods of Mummery and others, but as the author does not recognise the epoch-making results of the above-named investigator's work, no mention is made of the nerves of the dentine, and, although the plates have been entirely re-drawn, no new ones have been added depicting the results which led Mr. Mummery to his conclusions. Several of the original illustrations in the text have been omitted from this edition, chiefly those dealing with histological and bacteriological apparatus.

PRINCIPLES AND PRACTICE OF OPERATIVE DENTISTRY. By JOHN SAYRE MARSHALL. Fourth edition. Illustrated; pp. xxvii + 698. Price 21s. net, 8vo. Philadelphia and London: J. B. Lippincott Co., 1914.

In the fourth edition of this work is presented a comprehensive text-book of the science and art of dental surgery, excluding, however, the subject of irregularities of the teeth, which the author considers a separate speciality. Recent microscopical researches are fully referred to in the chapters on the histology of the dental tissues, including Mummery's investigations demonstrating the existence of nerve-fibres in the dentine. This section of the book is supplied with reproductions of photomicrographs of the various dental tissues and of the process of development of the teeth. The important subject of the prevention of dental caries has received special attention, especially with regard to the influence of the various foods, and the observations of Gies, Pickerill, and Sim Wallace in this connexion are all enumerated. The introduction of nitrous oxide and oxygen "analgesia," or, as the author prefers to call it, "peripheral anæsthesia," is referred to, and a caution added as to the possible dangers of the indiscriminate use of this method. A chapter on electro-therapeutics has been added, dealing with the uses of the galvanic and faradic currents in dentistry, especially the application of the former in morbid conditions of the pulp and periodontal membrane, and as a means of diagnosis in determining the vitality of the pulp. Apart from these additions, the general plan and details of the book remain the same as in the previous editions.

PASTEUR AND AFTER PASTEUR. By STEPHEN PAGET, F.R.C.S. Pp. xiv + 152. Price 3s. 6d., small 8vo. London: Adam and Charles Black, 1914.

When the grave closed over the mortal remains of Louis Pasteur, Nature lost a friend and Science mourned a genius. Pasteur's discovery of molecular dissymmetry, leading as it did to the elucidation of the problem of fermentation, laid the foundation of all his future success. The irrefutable proof that fermentation, decomposition, and putrefaction are the results, not of any creative constituent of the air itself, but of bacteria derived from extraneous sources, enabled him, in 1864, to expound the germ theory in one memorable phrase: "*La vie, c'est le germe, et le germe c'est la vie.*" Darwin had said: "The origin of life! As well might one argue upon the origin of matter," and Pasteur was of the same opinion. He quietly proved a negative, by showing that a liquid really sterile, exposed to air really sterile, will remain sterile; the old theory of spontaneous generation was henceforth dead and buried. The result of his studies in fermentation had enabled him to revolutionise the manufacture of wine, beer, and vinegar; he had saved the silk trade by the discovery of the cause of silk-worm disease; and he thereupon proceeded to the investigation of anthrax, to which 5 per cent. of the cattle and 10 per cent. of the sheep in France had yearly fallen victims. Thence he turned to the study of *rouget* (swine disease) and fowl cholera, in the course of which latter research he advanced from the making of cultures to their attenuation, thus evolving the principle of immunisation which has already preserved the lives of myriads of the human race, and has made the name of Pasteur immortal. Finally he devoted himself to rabies, the preventive treatment of which was his last personal achievement. "*Si j'avais l'honneur d'être chirurgien,*" was his one lament, as if he had not done enough; though, in fact, it was he who had cleared the ground for Lister and others, and had made possible the protective treatment of tuberculosis, diphtheria, cholera, plague, typhoid fever, and malaria. Everyone should read Radot's "Vie de Pasteur," in French if possible, to which this little volume, the first of a series of medical history manuals, forms a fitting introduction; and those who would become imbued with the spirit of the master who is revered by not a few as the greatest scientific genius of all time, should visit his tomb in the chapel of the institute in Paris which bears his name, on whose walls, decorated with hops, vines, mulberry-leaves, and the figures of cattle, sheep, dogs, and poultry, may be read the names of his great discoveries, and over which are watching the four white angels of Faith, Hope, Charity, and Science. Louis Pasteur died, crucifix in hand, beloved of all men; the very animals, could they speak, would bless his memory.

QUAIN'S ELEMENTS OF ANATOMY. Editors: Sir EDWARD ALBERT SCHAFER, LL.D., F.R.S., JOHNSON SYMINGTON, M.D., F.R.S., and THOMAS HASTIE BRUCE, M.D. Eleventh edition. In four volumes. Vol. IV, Part 1: "Osteology and Arthrology," by T. H. BRYCE. Illustrated; pp. viii + 329. Price 12s. 6d. net, large 8vo. London: Longmans, Green and Co., 1915.

This first part of the fourth volume of "Quain's Anatomy" forms a text-book complete in itself. The order of description in the first part dealing with osteology is that of the skeleton and bones generally, vertebral column, thorax, bones of the head, upper limb and lower limb, concluding with morphology of the limbs. The second half, arthrology, is arranged under articulations in general, followed by those of the trunk and head, upper limb, pelvis and lower limb. The Basle nomenclature is very largely employed; the English equivalents are principally used in the text, and the Latin forms given on the figures. The woodcuts of the bones that appeared in the tenth edition have been reproduced; some fresh figures have been added in the osteology section. A new feature in the section on arthrology is a set of new coloured plates. Another fresh feature in the work is the addition of a bibliographical appendix of the more recent literature on osteology, which is very extensive, consisting principally of brief papers and annotations.

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SUPPLEMENT

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NOTES ON BOOKS.

[*The purpose of these "Notes" is neither to praise nor to blame, but merely to draw attention to some of the new books and new editions which have been added to the Society's Library.*—Ed.]

A CORRECTION.

Practical Nursing: A Text-book for Nurses. By Anna C. Maxwell and Amy E. Pope. Third edition. Illustrated; pp. xvi + 864. Price 7s. 6d. net. New York and London: G. P. Putnam's Sons, 1914.

In our note on this book we referred to the absence of an index, but the publishers inform us that an imperfect copy had been accidentally sent to us, and we have now received a copy containing an apparently adequate index of some eight pages.

Serology of Nervous and Mental Diseases. By D. M. Kaplan, M.D. Pp. 346. Price 15s. net. Philadelphia and London: W. B. Saunders and Co., 1914.

From the preface we learn that there is no American work covering the subject of the serology of nervous and mental diseases, and that a collection of the articles which have appeared in various medical periodicals is a serious requirement. Lumbar puncture with the object of obtaining cerebrospinal fluid, and its examination as an aid to diagnosis, is nowadays a frequent procedure; and the first part of this volume contains an exposition of the technology of the operation and the interpretation to be placed upon the chemical and morphological findings. The chapter on the technique of the Wassermann reaction concludes with the author's opinion, of which, as that of an experienced serologist, due notice should be taken, that "the chief function of the laboratory worker is not so much to detect every luetic subject as to protect the non-syphilitic individual from a wrong diagnosis and useless treatment" (p. 82); and, with this object in view, he urges that "when submitting a serum for analysis, it is important, in order to obtain an unbiased opinion from the laboratory, to withhold the clinical findings in the case" (p. 81). Parts II and III are devoted to the serology of nervous and mental diseases of syphilitic and non-syphilitic origin respectively, and Part IV to the therapeutical use of salvarsan. There are several illustrations demonstrating the technique of lumbar and veni-puncture, and others of various apparatus, &c.; and the volume concludes with a useful bibliography extending to 70 pages, and an index of contents.

ANÆMIA AND RESUSCITATION: AN EXPERIMENTAL AND CLINICAL RESEARCH. By GEORGE W. CRILE. Pp. xvi + 305. Price 21s. net. New York and London: D. Appleton and Co., 1914.

From the preface we learn with satisfaction that it has seemed best to the author to publish in detail the experiments upon anæmia and resuscitation which have been conducted in his laboratory, so that other workers may be saved unnecessary repetition. These experiments comprised the systematic investigation of the comparative effects of total anæmia upon different organs and tissues, and the extent of duration of that condition which these will respectively endure; whence the author has been led to the conclusion that such power of endurance is in (inverse) proportion to the delicacy of the function of the viscus or tissue involved (p. 250). We are reminded in the preface that, since the continued normal action of the heart and lungs is dependent upon the activity of the brain, the presence or absence, as well as the degree in duration of anæmia of the latter organ, decides the possibility of resuscitation; and also that it has not been sufficiently appreciated that, in regard to the resuscitation of the body as a whole, the greatest and most essential difficulty is to overcome the anæmia of the brain. The technique of the various methods of heart resuscitation with this object is given in detail; of which it has been found that the most efficient means of re-establishing the cerebral circulation is by the use of saline-adrenalin infusion towards the heart, combined with rhythmical pressure upon the thorax. There is a useful bibliography.

BLOOD-PRESSURE: ITS CLINICAL APPLICATIONS. By GEORGE WILLIAM NORRIS, A.B., M.D. Pp. viii + 371. Price 12s. 6d. net. Philadelphia and New York: Lea and Febiger, 1914.

The author's endeavour has been to present in a condensed and practical form the subject of blood-pressure, much of the literature of which is to be found scattered among the medical periodicals of various countries. Having described the physiology of normal human blood-pressure and the definitions which are generally accepted (the term "mean pressure" seems to be used by authors in different senses), he proceeds to its estimation by various instruments and methods. Parenthetically it is interesting to note that the first exact measurements of blood-pressure were published as long ago as 1733 by the Rev. Dr. Stephen Hales in his "Statical Essays"; an author whose philosophical ingenuity designed a system of ventilation, and whose clerical and quasi-medical knowledge found expression in "A Friendly Admonition against Brandy," which, he says, "coagulates and thickens the blood, and contracts the narrow vessels," &c. The variations of blood-pressure in the infectious diseases, in conditions consequent upon the exhibition of poisonous substances (e.g., lead, morphine), and in diseases of the nervous system, are described in the chapters following, one of which refers to the effects of drugs and glandular extracts upon the circulation. Chapter XVII treats of blood-pressure in surgery and obstetrics, and commences with the suggestion that "readings should be made in all cases in which anæsthetics or surgical procedures are employed, both before, and if possible during, as well as after the operation. Arterial hypertension will often indicate the presence of renal disease, when the routine urine examination fails to reveal it."

ARTIFICIAL PARTHENOGENESIS AND FERTILISATION. By JACQUES LOEB. Pp. x + 312. Price 10s. net, 8vo. Illinois: University of Chicago Press, 1913.

This is a supplemented and revised edition of a work, published in German and translated into English by King, in 1909, containing an analysis of the mechanism by which the spermatozoon causes the development of the egg; which analysis has been made possible by the discovery of the power to imitate the action of the spermatozoon by physico-chemical means —i.e., artificial parthenogenesis. Whereas the unfertilised egg dies in a comparatively short time, the fertilized egg lives indefinitely, since it gives rise not only to an individual, but may produce an endless series of generations. The act of fertilisation is, so far, the only known means by which the natural death of a cell can be prevented, and experiments on the mechanism of fertilisation are, in reality, efforts to determine the causes of the prolongation

of cell life. The effects of the spermatozoon upon the egg are both developmental and (paternally) hereditary, of which the developmental effect can be produced upon the egg of one animal by the spermatozoon of quite different species, but end only in the production of the original type of the egg, not the paternal type of the spermatozoon. It is to the study of this developmental effect of the spermatozoon, or rather of the physico-chemical forces which are known to be substituted for the spermatozoon—i.e., artificial parthenogenesis—that this work is devoted. The process by which the forces of hypertonic sea-water were proved to be an effective substitute for the spermatozoon is described in detail, together with the author's later discoveries as to the causes of the formation of the vitelline (fertilisation) membrane, which is the essential step towards development.

THE EARLY DIAGNOSIS OF HEART FAILURE, AND OTHER ESSAYS ON THE HEART AND CIRCULATION. By T. STACEY WILSON, M.D.Edin., F.R.C.P.Lond., B.Sc.Edin. Illustrated; pp. xx + 617. Price 12s. 6d. net, 8vo. London: Smith, Elder and Co., 1915.

This book of nearly 600 pages consists of a number of essays, written during the last twenty years, dealing chiefly with heart failure; and they have especial reference to the diagnosis of this condition both by clinical methods and by the observation of symptoms. The subject is discussed in very much more detail than is possible in the ordinary text-book. The first essay occupies one quarter of the book, and is devoted to the early diagnosis of heart failure at different periods of life, and in different conditions of the heart's muscular substance. Other essays have reference (*a*) to varying positions of the diaphragm, as guides to the condition; (*b*) to variations in the hepatic dullness as an index of the heart's capabilities; (*c*) to overstrain of the heart; (*d*) to displacement of the heart under varying conditions; and (*e*) to anæmia and pallor as related to heart failure. One essay is largely devoted to a study of the causation of the systolic pulmonary murmur of anæmia; another to the so-called third sound of the heart; and another to a case of arrhythmia, which bears strongly on the venous pulse and the action of the auricles. The essays raise extremely important questions, and will be of great interest to anyone who has had a little experience in the study of cardiac cases. The author does not discuss the treatment of heart failure. The book is very fully illustrated by diagrams and photographic plates of the results of percussion of the heart, lungs, and liver, and by tracings of the arterial and venous pulses and of the heart's beat.

A MEDICAL DICTIONARY FOR NURSES. By AMY E. POPE. Pp. 288. Price 7s. 6d. net. New York and London: G. P. Putnam's Sons, 1914.

The purpose of this book is to provide a medical dictionary containing a detailed definition of the words and terms which are of special importance to nurses. It does not profess to contain all those which are usually included in medical lexicons, but it is contended that those which are omitted are not likely to be looked for or commonly met with by nurses. A list of the abbreviations usually employed in prescriptions, with an explanation of their respective meanings; the chemical symbols of the commoner compounds and a table of the elements; another of the poisons, with their symptoms and antidotes; a descriptive list of the prefixes and suffixes attached to medical terms; a comparison of the readings of Centigrade and Fahrenheit, and tables of weights and measures are appended; and the contents of the volume are completed by a summary of the average composition of common American food-products. The compiler is already known, more especially in America, as the author of several elementary books for nurses, and her experience of teaching enables her to make judicious choice of the words and subjects which are most likely to present difficulties to nurses in general.

SQUIRE'S POCKET COMPANION TO THE BRITISH PHARMACOPŒIA. By PETER WYATT SQUIRE. Second edition; pp. xvi+1040. Price 10s. 6d. net. London: J. and A. Churchill, 1915.

The previous edition of Squire's Pocket Companion, which was published in 1904, arose out of the need for a more handy volume than the original Squire's Companion, which had

attained great bulk. It was therefore thought advisable to publish two separate books, of which the smaller Pocket Companion gives information specially suited to the practitioner and dispenser on such matters as commonly arise in the ordinary course of prescribing and dispensing; while the larger Companion combines the information embodied in the smaller work, with notes on improved pharmaceutical processes, criticisms of official tests, &c. The alphabetical arrangement has the advantage of easy reference without constant recourse to the index; and the "Prescribing Notes," which have been entirely revised and considerably enlarged, form a special feature of the present edition. Doses are given in both the Imperial and Metric systems, and in the case of toxic drugs the maximum single and daily dose is noted, together with selected formulas from the pharmacopœias of foreign countries and of the London hospitals. Each monograph contains a description of the drug to which it refers, with the usual method of preparing it, the official and not-official preparations, its incompatibles and antidotes, and the changes (if any) in the new British Pharmacopœia, which are indicated by the words New, Altered, or Modified, in brackets. A special chapter has been written upon the Therapeutical Agents of Microbial Origin (antitoxins, serums, vaccines, &c) by R. Tanner Hewlett, Professor of Bacteriology in the University of London; and a list of the spas of Europe, classified therapeutically, and a general index, complete this pocket companion.

THE EXTRA PHARMACOPŒIA OF MARTINDALE AND WESTCOTT. By W. HARRISON MARTINDALE, Ph.D., F.C.S., and W. WYNN WESTCOTT, M.D.Lond., D.P.H. Volume I, revised; pp. xl + 1113. Price 14s. net. London: H. K. Lewis, 1915.

The sixteenth edition of the Extra Pharmacopœia would need little introduction to the medical profession were it not necessary to direct attention to the importance of the additions and alterations which have been made, while the general characteristics of the last edition have been retained. The first volume includes everything which the physician and pharmacist are likely to require for immediate reference on therapeutical matters; and at the same time that all material superseded by the most modern research has been omitted, over 2,000 abstracts from recent issues of the scientific journals of the world have been added. In order to bring the work into line with the New British Pharmacopœia, a synopsis of the changes in the latter, indicating the additions, deletions, and alterations, has been provided, the doses being given in both the Imperial and Metric systems. Besides a much enlarged account of the therapy of vaccines and antitoxins, and a chapter on animal organo-therapy (animal glands and tissues, and their preparations), special attention may be drawn to the information given on the subjects of the metallic colloids, kataphoresis, and radiology; while the supplementary list of drugs affords many details of the more out-of-the-way Materia Medica.

THE EXTRA PHARMACOPŒIA OF MARTINDALE AND WESTCOTT. By W. HARRISON MARTINDALE, Ph.D., F.C.S., and W. WYNN WESTCOTT, M.B.Lond., D.P.H. Volume II, revised; pp. viii + 469. Price 7s. net. London: H. K. Lewis, 1915.

The second volume of this, the sixteenth edition of the Extra Pharmacopœia, provides the physician with directions for the examination of the urine, blood, sputum, &c., for pathological metabolic products; and will be consulted by the pharmacist, chemist and analyst to determine the latest chemical and pharmacological methods of assaying drugs, chemicals, and organo-therapeutical medicaments. Herein may also be found information upon the sterilisation of solutions and utensils, and upon the standardisation of disinfectants and antiseptics, and their carbolic coefficients. A summary is given of the Report of the Parliamentary Committee upon Proprietary Medicines, with the ingredients of each of the latter, and a list of the European spas, and the analysis and therapeutical properties of their waters; while that portion of the work which is devoted to bacteriological and clinical notes upon special diseases also includes cancer, syphilis, and tuberculosis, and conveys information that should interest every medical practitioner.

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NOTES ON BOOKS.

[*The purpose of these "Notes" is neither to praise nor to blame, but merely to draw attention to some of the new books and new editions which have been added to the Society's Library.*—Ed.]

An Index of First-Aid. By J. M. Carvell, M.R.C.S., L.S.A.Lond. Illustrated. Price 1s. net. London: John Bale, Sons and Danielsson, Ltd., 1915.

This vade-mecum for the ambulance worker and those anxious to gain some knowledge of first-aid to injured persons provides an instant guide in emergencies by reason of its alphabetical arrangement. It contains some diagrams of the various knots used in ambulance work, and the ruled interleaves afford an opportunity for the addition of manuscript notes.

Strangeway's Veterinary Anatomy. Ninth edition. Illustrated. Price 24s. net. Edinburgh and London: W. Green and Son, 1915.

This is the ninth edition of a work dealing primarily with the veterinary anatomy of the horse, which is taken as the type of all the domesticated animals, deviations from which type constitute the comparative anatomy of the subject. The work contains chapters on the bones, joints, muscles, viscera, vessels, nerves, organs of sense, and embryology, the last part of each of which chapters is devoted to a description of the differences which exist between the anatomy of the horse and that of the various other domesticated animals—i.e., the Ruminantia, Omnivora, Carnivora, Rodentia, and Aves. There are numerous illustrations and an index.

The Year-Book of Open-air Schools and Children's Sanatoria. Edited by T. N. Kelynack, M.D. Volume I. Illustrated; pp. xxxii + 444. Price 7s. 6d. net. London: John Bale, Sons and Danielsson, Ltd., 1915.

This is the first issue of a year-book, new in design, and object, which the promotors trust will become an annual publication useful to all medico-educational workers. The opening pages are devoted to an editorial review, and this is followed by many original communications, contributed by medical men and women, architects, and others, including an article on "The Scouts and the Nation," by Sir Robert S. S. Baden-Powell. Thus the scope of the publication appeals to a wide circle of readers. Other features embrace "Clinical Surveys," "Schemes for Open-air Education and Treatment," a long list of sanatoria and other institutions designed for the treatment of children, and much official information. The volume contains many illustrations, emphasising the teaching of the text, and is fully indexed.

EVOLUTION AND DISEASE. By J. T. C. NASH, M.D. Pp. viii + 73. Price 3s. 6d. net. Bristol: John Wright and Sons, Ltd., 1915.

This book is the outcome of the Chadwick Lectures, delivered by the author in 1913. The first three chapters are briefly historical in the matter of records of mediaeval epidemics, and, as the author points out, they are necessarily brief, inasmuch as the records in question are wonderfully uninformative and meagre, "even to the extent of a bare chronology in most instances." In the sixteen chapters of which the book consists many subjects are dealt with, upon which original views are expressed by the author. In the chapter upon "Insanitation, an Evolutionary Factor in Epidemics," he traces how dense overcrowding led to the production and maintenance of filth conditions, constituting an environment in which epidemics of disease were continually recurring. These conditions prevailed in the large towns only some sixty or seventy years ago. In this connexion he refers to typhus fever, epidemics of which were of common occurrence, and attributes the present absence of the disease to the "rigorous application of powers for preventing overcrowding," and to the prevalence of personal and domestic cleanliness. Among other chapters which may be mentioned are those on "Heredity and Disease," the "Declension of Phthisis," the "Evolution of Disease and Disease Germs," the "Evolution of Sanitation," and "War as a Factor in the Evolution of Epidemics," the latter having an especial bearing upon the campaign at present in progress. There is no index.

THE PHILOSOPHY OF CHANGE: A STUDY OF THE FUNDAMENTAL PRINCIPLE OF THE PHILOSOPHY OF BERGSON. By H. WILDON CARR, Hon. D.Litt.Durh. Pp. xii + 216. Price 6s. net. London: Macmillan and Co., Ltd., 1914.

This book is based upon a course of lectures on the Philosophy of Bergson delivered in the University of London. The author submits that the present generation is witnessing a wide extension of science in directions unimagined and inconceivable by the last generation, and that "experiment is opening up realms of reality, the existence of which has until now been unsuspected, and the discovery of which is probably destined to widen the horizon of human knowledge, and thus increase human power." The theme is dealt with in nine chapters, and includes such subjects as "The Doctrine of Intuition," "The Mind and Body," "Matter and Spirit," "The Vital Impulse," "God, Freedom, and Immortality," "The Idea of a Reality which Creates and is Free," in which the views of many philosophers are referred to and discussed.

A TEXT-BOOK OF PATHOLOGY FOR STUDENTS OF MEDICINE. By J. GEORGE ADAMI, M.A., M.D., F.R.S., and JOHN MCCRAE, M.D., M.R.C.P.Lond. Second edition, revised and enlarged. Illustrated; pp. viii + 878. Price 25s. net. London: Macmillan and Co., Ltd., 1914.

The changes in the new edition of this work are of a somewhat comprehensive nature. The revision of each subject has been carefully undertaken, with a view to incorporating all trustworthy advances that the past two years have introduced. A new chapter has been added upon "The more important Infections and their Prominent Features." Another new feature, convenient for reference, is the syllabus placed at the beginning of each chapter, detailing its contents, with page references. The chapter on "Monstrosities and Abnormalities" has been placed as an appendix, while the volume contains no fewer than ninety-one additional engravings and two coloured plates.

LECTURES TO NURSES; BEING A COMPLETE SERIES OF LECTURES TO PROBATIONARY NURSES IN THEIR FIRST, SECOND, AND THIRD YEARS OF TRAINING. By MARGARET S. RIDDELL. Illustrated; pp. xii + 351. Price 3s. 6d. net. London: The Scientific Press, Ltd., 1914.

The training and education of the hospital nurse are well provided for by the literature which especially caters for her instruction. The author of this book, the latest upon the subject, is the sister of the senior surgeon of the Aberdeen Royal Infirmary. In the preface

we learn that the proof-sheets have been revised by him; the work, therefore, appears under the ægis of medical authority. The lectures have been designed to afford a progressive course of instruction. There are ten devoted to first-year probationers, ten to probationers of the second year, and the same number to probationers of the third year. The remarks, in the introductory chapter, upon hospital etiquette are well-timed and useful, especially as it is a subject which hospital matrons often fail to impress upon their juniors. The behaviour of the present-day probationer towards those in authority over her is commonly very far from what it should be, in the matter of a respectful bearing. The first course deals mostly with elementary matters, and includes remarks upon counter-irritants, fractures, and hæmorrhage. The second course is mainly devoted to infectious diseases, wounds, poisoning, burns, and the nursing of acute cases. The third course explains asepsis and antisepsis, sterilisation, describes the operating theatre, and the nursing of cases in the special departments, concluding with notes on electricity and massage. A copious index completes the volume.

AN INDEX OF SYMPTOMS, WITH DIAGNOSTIC METHODS. By RALPH WINNINGTON LEFTWICH, M.D. Fifth edition. Illustrated; pp. xii + 516. Price 7s. 6d. net. London: Smith, Elder and Co., 1915.

This new edition of the author's work is greatly enlarged as compared with previous issues. The increase in bulk is due to the addition of many new symptoms and tests, while the interlineary notes have been greatly amplified. A further new feature is the attempt to devise a scientific classification of symptoms. In view of its amplification the author affirms that his work is no longer a pocket book, but a book for the desk.

THE SURGERY OF THE STOMACH: A HANDBOOK OF DIAGNOSIS AND TREATMENT. By HERBERT J. PATERSON, M.A., M.C., M.B.Cantab., F.R.C.S.Lond. Illustrated; pp. xx + 342. Price 15s. net. London: James Nisbet and Co., 1914.

This second edition of Mr. Paterson's book on the surgery of the stomach, following as it does the first edition after an interval of only a year, has not involved extensive revision. Some minor alterations have, however, been made. One new feature is the reproduction in pairs of stereoscopic photographs of the operation of gastro-jejunostomy. Though the pathology of the diseases treated of is not passed over, the subject is discussed principally from the clinical point of view. References to the work of others are freely given, but the author, in his descriptions, trusts very largely to his own wide experience. The surgery of the stomach is very completely dealt with. The book is embellished by copious, mostly photographic, illustrations.

THE BOOK OF PHARMACOPŒIAS AND UNOFFICIAL FORMULARIES. By E. W. LUCAS, F.I.C., F.C.S., and H. B. STEVENS, F.I.C., F.C.S. Pp. viii + 524. Price 7s. 6d. net. London: J. and A. Churchill, 1915.

Intended for practical pharmacists, this book presents in comparative tables, side by side, the formulas contained in the pharmacopœias of Great Britain, the United States, France, Germany, and Italy, together with extracts from the unofficial formulas of these countries and of the London hospitals. The commonly used Latin name of each of the preparations has been adopted as far as possible, the synonyms being added, reference to each of which is given in the index. The Imperial System of weights and measures has been adhered to without giving the metrical equivalents; but whereas the British and American formulas are to be prepared according to the rule of "solids by weight, liquids by measure," in the preparation of foreign formulas both solids and liquids should be weighed. Brief notes upon those processes to which reference is made in the body of the work are appended, and are followed by an alphabetical list of the materia medica under their French, German, and Italian names, with their English equivalents, and a general index.

THE DISPENSARY TREATMENT OF PULMONARY TUBERCULOSIS. By HILDA CLARK, M.B., B.S.Lond. Tables; pp. viii + 279. Price 15s. net. London: Baillière, Tindall and Cox, 1915.

This account of the author's experience of tuberculin treatment extends over a period of three years (1910-13), and embraces only those cases which have been under her own observation; the investigation being carried out with three main objects: (1) To estimate the value of tuberculin treatment; (2) to estimate the position of that treatment in any scheme designed to deal with the special problem of tuberculosis among the working classes; and (3) to estimate the incidence, course, and response to treatment of tuberculosis in the population of a selected manufacturing village, where peculiar opportunities existed for such an investigation. It is claimed that a consecutive series of cases, treated on the same general lines, derived from a stable, homogeneous population living under good hygienic conditions, is best suited for the study of the value and method of any scheme intended for the general treatment of tuberculosis, since they show, not only the conditions occurring before tubercle becomes complicated by extreme poverty or discharge from work, but also the residue of tubercle which remains to be dealt with when certain obvious causes of massive infection and of damage to general health have been eliminated. In these investigations the discovery of the bacillus in the sputum was considered the only certain proof of lung infection, but in studying the position of tuberculin treatment in a scheme for the eradication of tuberculosis, special attention must be paid to those persons in whose sputum no bacillus is found, since among them must be the early cases with which preventive measures are concerned, and in which complete cure is possible. The author concludes that tuberculin can be used with apparently good effect in nearly every case in which ordinary clinical methods point to a prognosis of improvement; that in a large proportion of cases, in an early stage or limited in extent, tuberculin results in apparent cure; and that a course of tuberculin is a justifiable and safe treatment in cases which show no bacilli or other evidence of active tuberculosis, but which react to tuberculin. If these conclusions be accepted, the author contends that the administration of tuberculin should be adopted in any scheme for the eradication of tuberculosis.

FLIES IN RELATION TO DISEASE: BLOOD-SUCKING FLIES. By EDWARD HINDLE, B.A., Ph.D. Illustrated; pp. xvi + 398. Price 12s. 6d. net, 8vo. Cambridge: At the University Press, 1914.

The main object of this book is to lay before the public the part that is taken by suctorial flies in the transmission of disease. In pursuing it the author has given in considerable detail an account of the classification of the insects involved, of their habits and habitats, and of the means at our disposal for attacking them. The history, symptomatology, and treatment of the many diseases which they cause is also dealt with at some length. These two parts of the subject are naturally treated alternately, as each class or species is under discussion. The reader therefore meets with sections that are highly technical, followed by those of more general interest. The book travels over a very wide field, and is the complement or companion of a volume in the same series dealing with the non-suctorial flies, noticed in our issue of December, 1914, No. 2 (Supplement: Notes on Books), p. 11.

THE BLOOD: A GUIDE TO ITS EXAMINATION AND TO THE DIAGNOSIS AND TREATMENT OF ITS DISEASES. By G. LOVELL GULLAND, M.A., B.Sc., M.D., F.R.C.P.E., and ALEXANDER GOODALL, M.D., F.R.C.P.E. Second edition. Illustrated; pp. xvi + 384. Edinburgh and London: W. Green and Son, 1914.

The first edition of this work, which was published in 1912, was intended to place before the student and practitioner a concise and clear account of the diseases and the diseased conditions of the blood and blood-forming organs, which account, in this edition, has been entirely revised and in part rewritten. The authors have preferred to rely upon their own clinical and pathological experiences rather than upon the collation of the views of

others, and have described fully only those methods which they have themselves found essential and useful, the less important methods being referred to their original sources of information, chief among which is the summary of hæmatological literature published under the name of "Folia Hæmatologica." The contents of the volume are arranged in five parts, the first of which is devoted to the methods of examining the blood, and the second to a description of its formed elements, while the remainder is given up to the consideration of its condition in diseases characterised by anæmia, leucocythæmia, the hæmorrhagic diatheses, &c., special diseases of the general organs and system, and those due to animal parasites. There is an appendix containing an account of the treatment of pernicious anæmia by splenectomy; and scattered through the letterpress are numerous illustrations of appliances and instruments, together with a series of coloured plates of blood cells in various pathological conditions.

EXTRACTION OF TEETH. By F. COLEMAN, L.R.C.P., M.R.C.S., L.D.S. Second edition; illustrated; pp. 174. Price 3s. 6d. net, 8vo. London: H. K. Lewis, 1914.

This issue is not considerably larger than the first edition of 1908, but it has been practically rewritten and rearranged, with the addition of more illustrations. The general surgical and anatomical principles governing the important operation of tooth extraction are supplemented by detailed consideration of the special technique which each class of tooth requires for its successful removal without breakage and the least amount of injury to alveolar and gum tissues. The suitability of various instruments for straightforward, as well as difficult, work is discussed in a manner easily referred to in either an easy or complicated case by the expert or general practitioner. Of the illustrations, some forty are devoted to depicting the forms of forceps, elevators, &c., the author considers most suitable; others showing the best method of handling and demonstrating the means of attacking hidden and inaccessible teeth or roots. The indications for general anæsthesia, local or regional analgesia, are considered, and the arising complications sufficiently indicated without trenching upon the legitimate grounds of a treatise on anæsthetics. Diagrams of tooth-forms and the relations of roots to surrounding structures of the maxilla and mandible should be of assistance to student and practitioner, who will also find notes on treatment of hæmorrhage and the various accidents and vicissitudes that invariably accompany the "minor" but often serious operation of tooth extraction. There are references to the writings of Dr. Blumfeld and Mr. A. D. Fleming in the *Proceedings of the Royal Society of Medicine* upon the sequelæ of local anæsthesia.

LYON'S MEDICAL JURISPRUDENCE FOR INDIA, WITH ILLUSTRATIVE CASES. By L. A. WADDELL, C.B., C.I.E., LL.D., M.B., F.L.S. Fifth edition. Price 28s. net. Calcutta and Simla: Thacker, Spink, and Co., 1914.

The fifth edition of this well-known book on medical jurisprudence in India has been largely rewritten and many additions have been made. A full account of medical evidence and procedure is given, and special attention is directed to the difficulties of ascertaining the truth in criminal cases in India, such as the rapid decomposition of the body which tends to occur, the untrustworthiness of native evidence, and so forth. The methods of identifying by means of finger-prints are described. Included in the accounts of death from various forms of violence are descriptions of the injuries and effects produced by daggers, spears, and arrows. Part II, which deals with toxicology, occupies nearly half the book. In addition to the familiar poisons, accounts are given of various poisonous plants, unknown or little known in this country, but frequently the means of poisoning in India. The statistical information is, in some cases, rather out of date. Lieut.-Colonel W. D. Sutherland, M.D., contributes a chapter on the examination of blood-stains. He describes the recent biochemical tests, and considers that they afford an accurate means of determining the origin of a blood-stain. The illustrative cases given go a long way to support this conclusion. There is a plate showing the results of the precipitation test for human blood.

THE VICIOUS CIRCLES OF NEURASTHENIA AND THEIR TREATMENT. By JAMIESON B. HURRY, M.A., M.D.Cantab. Diagrams; pp. xvi + 90. Price 3s. 6d. net, 8vo. London: J. and A. Churchill, 1915.

Some years ago the author drew attention to the important part played by the vicious circle in disease, and showed how a study of it might be helpful in diagnosis, prognosis, and treatment. In the present work an attempt is made to indicate the influence of the circle in one particular disorder—i.e., neurasthenia. In Chapter I the pathology of this affection is discussed: the two dominant features are stated to be fatiguability and irritability, a combination which Sir William Gowers was wont to designate "irritable weakness." In subsequent chapters the writer discusses the influence of the circle in connexion with the psychoses (as illustrated by phobias, mental depression, anorexia nervosa, and insomnia) and disorders of the vascular, respiratory, digestive, and genito-urinary systems, and of the sense organs. Next, artificial circles are dealt with, to wit, those associated with alcoholism, narcomania, nicotism, the abuse of purgatives, the abuse of pessaries, the abuse of urethral sounds, and nosophobia. In Chapter IX the importance of breaking the vicious circle is insisted upon. In the concluding chapter the author dwells upon the need for a text-book of therapeutics based on the principle that the medical art mainly consists in the breaking of the circle.

THE ACUTE ABDOMEN. By WILLIAM HENRY BATTLE, F.R.C.S. Second edition, enlarged and illustrated; pp. xii + 295. Price 10s. 6d. net. London: Constable and Co., Ltd., 1914.

Many additions have been incorporated in this new edition. First, most of the subject-matter of the author's oration given before the Medical Society of London in 1910 is included. Again, a special section is devoted to the after-effects of abdominal injuries; other sections deal with perforations of tuberculous ulceration of the intestine; perforations of diverticula of the large bowel; intraperitoneal abscesses; concealed abscesses; sigmoiditis, and torsion of the omentum. In Part VII is discussed diverticulum of the cystic duct of congenital origin. Thus the work, in its enlarged form, in this second edition, contains many new features, illustrative of practical experience of the subject with which it deals.

A CLINICAL STUDY OF THE SEROUS AND PURULENT DISEASES OF THE LABYRINTH. By Dr. ERICH RUTTIN, Privat-Docent in the Otological Clinic of Vienna, with a Preface by Professor URBANTSCHITSCH. Translated from the German by HORACE NEWHART, A.B., M.D., Instructor in Otology, University of Minnesota. Illustrated; pp. viii + 232. Price 8s. 6d. net, 8vo. London: W. Heinemann, 1914.

The object of this monograph is to furnish American and English students who have attended the Vienna clinic of otology under Professor Urbantschitsch and Dr. Ruttin with a compendium of the lectures and demonstrations in their own language. To others it constitutes almost the only manual of instruction devoted to this department of surgery. The first hundred pages are descriptive of the science and treatment of labyrinthine disease. The study of the phenomena of nystagmus and disturbances of equilibrium is simplified as much as possible by the detailed and freely illustrated description of methods and tests in the chapter on functional examination of the cochlea and vestibular apparatus. The second chapter of this section takes up the consideration of the varieties of labyrinthitis, diffuse, serous, and purulent, their pathology, ætiology, and symptoms; the indications for the radical and the labyrinth operations, and the technique of the latter. Hints for practice are to be gleaned from the remarks upon temperature and febrile conditions, their importance in diagnosis and prognosis, and also upon the clinical termination of the forms of labyrinthitis. This section concludes with three chapters devoted respectively to Injuries of the Labyrinth, with statistics, Serous, induced Labyrinthitis, and Labyrinthitis with Brain Abscess. The remaining pages are devoted to the narration of 108 clinical cases, amply described, though somewhat abbreviated by the translator. Professor Urbantschitsch places his stamp of approval on this work in the "Foreword" contributed by his pen. There is a list of authors and an index.

Proceedings of the Royal Society of Medicine.

SUPPLEMENT

(Vol. VIII, No. 6, April, 1915).

NOTES ON BOOKS.

[*The purpose of these "Notes" is neither to praise nor to blame, but merely to draw attention to some of the new books and new editions which have been added to the Society's Library.*—Ed.]

The Cancer Problem. By William Seaman Bainbridge, A.M., Sc.D., M.D. Pp. xix + 534. Price 17s. net. New York: The Macmillan Co., 1914.

The enormous literature now included in the area of the subject of cancer—an area, incidentally, which is yearly being increased by ardent workers—has been laid under contribution in the compilation of this work. To do more, however, than offer a brief description in this notice of some of the contents of this book would not be possible within the limits of our space. To all those, therefore, to whom the subject of cancer appeals, desirous of learning the present position of the cancer problem, we would recommend the perusal of the volume itself. The opening chapters deal with the ancient history of the disease and the history of modern cancer research. For America is claimed the inception of the movement for the study of cancer by Professor R. Pack in 1899, and in the same year the initiative of the movement in England is assigned to Sir Malcolm Morris. A detailed account is given of the Research Laboratories of the Middlesex Hospital, following which is a full report of the foundation of the Imperial Cancer Research Fund, in whose laboratories, as the author points out on a subsequent page (p. 151), the fact was first experimentally demonstrated that "surgical removal is as yet the only sure way in which an animal can be protected against the ultimate consequences of inoculation with cancer cells"—thus absolving "the surgical treatment of cancer from the last vestiges of the charge that it is unjustifiable." After the discussion of the zoological distribution of cancer, statistics are dealt with. These show the importance of chronic irritation as a causative factor; that the question of the relative increase of cancer is still undetermined; that the influence of heredity is almost negligible; that the *canard* of so-called cancer houses has no foundation in fact. Other sections are devoted to "Etiology" and "Histo-pathology"; to a résumé of the world's work on cancer research; to prophylaxis; to non-surgical treatment; surgical treatment; and inoperable cancer. There is also a section on the investigation of "cancer cures," which exposes the many fallacies and failures of such attempts. Among these the fiasco of Count Mattei's crudities is entertainingly narrated. As a last comment the author writes: "If cancer cells be cut out soon enough a permanent cure is effected." This is the fact which he maintains has been established upon the basis of our present knowledge of the disease, and is, in his opinion, therefore "sufficient to warrant the statement that we are travelling hopefully." A general bibliography, an index of authors, and a general index complete the volume.

FOOD PRODUCTS. By HENRY C. SHERMAN, Ph.D., Professor of Food Chemistry, Columbia University. Pp. x + 594. Price 10s. net, 8vo. New York: The Macmillan Co., 1914.

This is one of the many books published lately on the chemical composition and nutritive value of food. The general plan adopted in it is to devote a chapter to each important type of food covering (1) an account of its production and preparation for the market, with such brief statistical data as will indicate the relative economic importance of the industry; (2) the proximate composition and general food value; (3) questions of sanitation, inspection, and standards of purity; (4) special characteristics of composition, digestibility, nutritive value, and place in the diet. There is a full bibliography at the end of each chapter. It should be noted that the consideration of diet in disease does not come within the author's plan, and that the very extensive information on standards of purity and on food inspection applies only to America. The book concludes with a detailed table of "100-calorie portions" and a full index.

MANUAL OF MILITARY HYGIENE FOR THE MILITARY SERVICES OF THE UNITED STATES. By VALERY HAVARD, M.D. Illustrated; pp. xiv + 786. Price 25s. London: John Bale, Sons and Danielsson, Ltd., 1914.

Modern wars have shown how much the value of an army, as a fighting machine, is increased by the enforcement of the scientific principles of hygiene. The importance, therefore, of military hygiene is obvious. In peace time discoveries are made, of useful and beneficent import, which in war time can be turned to valuable account. But such discoveries are apt to be rapid in realisation; they may soon throw out of date previous knowledge—a fact to which the author of this book alludes. The first edition of his manual was published about four years ago; during this interval, however, the advances made in all branches of hygiene have been such that in this new edition the work has required much amplification and thorough revision. The volume is larger by 283 pages, and 23 more illustrations have been added. It now contains sixty-two chapters, a biographical list of the more recent works on hygiene, and an extended index. Respecting the three diseases most under notice among our forces on the Continent—namely, typhoid, tetanus, and "frost-bite"—it is not without interest to note some observations by the author so far as the military services of the United States are concerned. In the first place, antityphoid inoculation is held in high esteem. The results under the voluntary system proved so satisfactory and promising, that in June, 1911, the method was made compulsory for all recruits. "All men enlisting, unless they were over 35 years of age or have had a recent attack of the disease, are vaccinated against typhoid fever at the time that they are vaccinated against small-pox." Tetanus is lightly touched upon, the matter being dismissed in a page and a quarter. Only seventeen cases of the disease, with twelve deaths, occurred in the United States Army during eleven years, 1898-1908. A 3 per cent. alcoholic solution of iodine, and daily irrigation of the wound with hydrogen peroxide, are recommended for local treatment. In the treatment of frost-bite immersion of the part in ice-cold water, with continuous frictions, are advised. The Russian writers, however, claim excellent results from the use of hot water, as hot as can be borne.

ESSENTIALS OF HUMAN PHYSIOLOGY. By D. NOËL PATON, M.D., B.Sc., F.R.C.P.Ed., F.R.S. Fourth edition, revised and enlarged, with 213 figures in the text; pp. xx + 558. Price 12s. Edinburgh and London: W. Green and Son, 1914.

The last edition of this work having been issued seven years ago it became necessary, with the recent rapid advances of physiology, that this new edition should undergo much revision. Accordingly many sections have been rewritten, and the whole work has been brought up to date. Moreover, many re-arrangements of matter have been introduced, and less important details deleted, in order to give greater prominence to those points of the science which bear most directly upon medical and surgical science. The author, throughout the volume, lays

stress upon the intimate association of physiology with the study of disease, and emphasises his teaching by frequent reference to the disturbances of function associated with morbid conditions. The practical knowledge of physiology from this point of view in the present day is rapidly becoming of greater importance, one of the many proofs of which is to be found in the relation which the internal secretions bear to the processes of metabolism, and of their effects, when these secretions are at fault. In this new edition a more minute subdivision of the contents and an extended index have been incorporated.

INFECTION AND RESISTANCE: AN EXPOSITION OF THE BIOLOGICAL PHENOMENA UNDERLYING THE OCCURRENCE OF INFECTION AND THE RECOVERY OF THE ANIMAL BODY FROM INFECTIOUS DISEASE. By HANS ZINSSER, M.D. With a chapter on Colloids and Colloidal Reactions, by Professor STEWART W. YOUNG. Pp. xiv + 546. Price 15s. net. New York: The Macmillan Co., 1914.

The author of this book is the Professor of Bacteriology at the Columbia University, New York. He states, in the preface, that in the compilation of his work "all available sources of information have been freely used." Of this there is clear evidence. In an index of authors consulted is included no fewer than 920 names, a convincing testimony of the labour which the preparation of the book must have involved. The subject-matter is dealt with in twenty-one chapters, inclusive of the contribution by Professor Young, of which due notice is taken upon the title-page. Prominent among the features of this book is the attention given by the author to the historical details underlying this comparatively new and progressive science. In each particular section an historical survey precedes the subsequent description of the development of our knowledge upon the subject. Thus, for the students for whom the work has been written, this method implies facility of teaching; the foundations of the science are explained before any attempt is made to deal with the superstructure. The first chapter discusses "Infection and the Problem of Virulence"; the second, "Bacterial Poisons." Then follow two chapters upon "Immunity," in its various forms—natural, acquired, and artificial. Succeeding chapters include "Toxin and Antitoxin," "Bactericidal Properties of Blood Serum," "The Phenomena of Agglutination." A full account of "Phagocytosis" follows, to which four chapters are devoted, and the same number is given to "Anaphylaxis," forming the bulk of the book. The description of "Therapeutic Immunisation in Man" in chapter xix contains many practical details; lastly, a special chapter is given to Abderhalden's work on protective ferments. Although primarily intended for the student in medicine, this book nevertheless here and there discusses, from a critical aspect, the work of others, but "with as little prejudice," the author observes, "as the possession of a personal opinion in many cases has permitted."

A TEXT-BOOK OF RADIOLOGY. By EDWARD REGINALD MORTON, M.D., C.M.Trin., Toronto, F.R.C.S.Ed., &c., Past President of Section of Electrotherapeutics, Royal Society of Medicine. Illustrations; pp. xvi + 221. Price 7s. 6d., 8vo. London: Henry Kimpton, 1915.

This volume does not aim at being comprehensive, but at forming a guide to those taking up radiology for the first time, to help them to understand the various appliances and methods of using them, and to conduct them along the first steps in the use of the X-rays in the diagnosis and treatment of disease. Electrical principles are dealt with in the first chapter, so far as they apply to X-ray work. The X-ray tube comes in for full consideration, as a proper knowledge of its management is essential for successful results. The various types of installation are described in principle and drawings provided where necessary. Stereoscopic radiography and other methods of localisation of foreign bodies are described in detail, and some space is given to the interpretation of radiographs, though only experience can teach this art adequately. Chapters are given specially dealing with the examination of the thoracic, abdominal, and pelvic organs, not in an extensive way, but enough to form a foundation on which to base further study and experience. The last chapter is devoted to X-ray therapeutics. The volume is illustrated with a number of plates to which notes are appended as well as references to the text.

A History of the Indian Medical Service, 1600-1913. Volumes I and II. By Lieut.-Colonel D. G. Crawford. Illustrated. Price 28s. London: W. Thacker and Co., 1914.

In these two volumes a description is given of the origin and development of the Indian Medical Service, with biographical sketches of some of the remarkable men who have belonged to it. From the very earliest period of the existence of the East India Company medical men have been appointed to minister to the medical needs of its servants; and Colonel Crawford, in his account of the careers of the medical men, records the development of the Company's possessions until they were taken over by the Crown after the Indian Mutiny. He shows that during the whole period the influence of the medical officer has in no small degree contributed to the stability and acquiescence of our rule in India. This has been acknowledged many times, but by none in so practical a manner as by Lord Dalhousie and Sir James Outram, in their important memoranda concerning the value of the medical service to India and the justice of according to it a high status among the services of the country. If any selection of chapters be made, perhaps those devoted to Dr. Gabriel Boughton, Dr. William Hamilton, and Dr. John Holwell, who, each in his own time, rendered great and valuable service to the East India Company and to the English nation, may be singled out as of particular interest. The author has not attempted to trace the causes or to describe the beginnings of the wonderful development of the I.M.S. during recent years, but he has provided the dry bones in readiness for the writer who, equipped with the necessary knowledge and inspired by the necessary enthusiasm, shall one day make these dry bones live. It is a story well worth telling, and perhaps Colonel Crawford, now that he has collected the *mémoires pour servir*, will himself attempt it.

The Inevitable Complement: the Care and After-care of Consumptives. By Harold Vallow, M.D. Pp. viii + 66. Price 1s. 6d. London: John Bale, Sons and Danielsson, Ltd., 1915.

The preface explains that the contents of this booklet have been prepared with the intention of helping the various bodies engaged in dealing with the suppression of phthisis to provide for the care and after-care of the patient. Not only is it necessary that he should be placed in a sanatorium and remain there for the requisite length of time according to his symptoms, but, in order that the good results obtained at those institutions should become permanent, some suitable dwelling and occupation after his discharge must be found for him. The author advocates for this purpose the formation of a Tuberculosis Unemployment Bureau, and gives a list of the most suitable forms of work for male and female consumptives; the main desideratum being open-air employment. He advises a system of visitation at the patient's home, and the provision of occasional help in the domestic duties, of extra nourishment, and of beds and bedding, so that each member of the consumptive household may have a separate bed. "For the attainment of success," says the author, "we must have the co-operation of all political parties, carried out on a non-political basis." While heartily endorsing his pious wish, we envy him his optimism.

Recreations of a Physician. By A. Stuart M. Chisholm. Price $2.00. New York and London: G. P. Putnam's Sons, 1914.

The author, an American physician, gives us ten essays, which he has read before different societies, and which have appeared in the *Journal of the American Medical Association*, or in the *Albany Medical Annals*. Those which have a specially medical interest are "Specialisation," "Physicians as Men of Letters," "The Inherent Spirit of Medicine,' "Some Features of Medicine in the Seventeenth Century," and the last, "On the Prevention of Disease." Of a more general literary interest are those entitled "Banquo," "The Symbolism of Names," "Royal Authors," "Some Translations of Horace," and "The Picaro in Fiction." The essays indicate a wide acquaintance with the literature and history of England, France, and Spain. In "Some Translations of Horace" the author introduces some of the odes, rendered by himself into English in the Horatian metres.

A Complete Handbook for the Hospital Corps of the U.S. Army and Navy and State Military Forces. By Charles Field Mason. Illustrated; pp. xviii + 596. Price 20s. London: John Bale, Sons and Danielsson, Ltd., 1914.

The author's object has been to prepare a handbook which would include in one volume of about 600 pages all the numerous subjects taught to the Hospital Corps of the U.S. Army and Navy, thus doing away with the necessity for several different volumes. The work is divided into twelve parts, the principal of which deal with Anatomy and Physiology, First-aid, Nursing, Diet, Therapeutics, Hygiene, and Minor Surgery, besides instructions for drawing reports and keeping records, and the Regulations for Ambulance and Hospital Drill. The book has the approval of the Surgeons-General of the U.S. Army and Navy, and supplies information in all essential medical and administrative detail. It is written in plain language, and is fully illustrated and indexed.

Practical Physiological Chemistry. By Sydney W. Cole, M.A. Fourth edition. Illustrated; pp. xvi + 258. Price 7s. 6d. Cambridge: W. Heffer and Sons, Ltd., 1914.

This is the fourth edition of a work originally intended for the medical student, which contains an account of the properties of the more important physiological substances and their significance, together with a detailed description of the various analytical processes employed in their estimation, in which reference the author inculcates the advantages of the modern micro-chemical tests for substances present in the blood and urine over the older so-called clinical methods. The early chapters are devoted to a consideration of the proteins, carbohydrates, and fats; the chemistry of certain common articles of food; and the composition of the digestive juices and ferments. The principal section of the work deals with the urine, and the methods used to obtain a quantitative analysis of its various constituents; while the appendix contains several of the most recent methods of estimating physiological substances in the blood and urine, respecting the accuracy of which the author has satisfied himself by personal experience. The rapid sale of the former editions points to the realisation by practitioners and students of the great importance of accurate analytical methods, the results of which are utterly unobtainable by the older tests.

Clean Water, and How to get it. By Allen Hazen. Second edition; revised and enlarged. 32 illustrations; pp. 196. Price 6s. 6d., foolscap 8vo. New York and London: John Wiley and Sons, and Chapman and Hall, 1914.

This non-technical but complete account of the sources and regulation of civic water supply, by a member of the American Society of Civil Engineers, is specifically limited to the developments of practice in the United States. Though the conditions of that country as compared with Europe imply smaller cities in general and less density of population, on the other hand, the average consumption of water *per capita* is very much greater; and the difficulties of storage and purification, to meet more varying rainfall and contamination, due to climatic causes and a higher temperature, are among the factors which have called forth great efforts. The allied—or even precedent—subject of sewage treatment is only parenthetically alluded to, the view being taken that of far greater importance is the physical, chemical, and biological purification of water during collection, storage, and distribution. An elementary but quite general and complete description is given of the principles involved in the selection of watershed or "catchment" areas, and in controlling and husbanding the supply from small and large lakes, rivers, and from the ground. The relative advantages of natural and artificial reservoirs are compared, and the construction of the latter, as to the behaviour of water in deep or shallow storage under different local conditions, and the geological character of the water sources described. Purification by "mechanical filtration" (which has a special technical meaning), by screening, subsidence, scrubbing, aeration, intermittent filtration, chemical or other disinfection, and the combinations of these which

have proved the most effective under certain conditions, are discussed in sufficient detail for their respective importance to be clearly understood. Illustrations, though on a small scale and pictorial rather than diagrammatic, are given of many municipal waterworks and their component departments. Data are given of the constructional elements of large filters, pumps, pressures and pipes, with their fittings, especially in relation to the secondary but disturbing and important considerations of supply for fire, power, and the sanitary service. Notwithstanding the enormous developments of the administration and design of hydraulic installations within the last few years in the United States, it is obvious that the much greater problem—with which the author is most concerned—is that of effectually coping with the impurities—suspended, in solution, or as determining taste and odour—of water, which so profoundly affect the health and comfort of the people. The difficulties surrounding this, arising from geological and climatic conditions and from the circumstance that populations so rapidly advance upon, and contaminate, specially selected areas of water collection, are set forth. A perusal of this account of American methods of dealing with local troubles, often of an exceptional nature, by special precautions, may be suggestive to sanitarians and officers of water authorities in more stable and settled communities. The book has a short index; there is no bibliography.

THE PRACTITIONER'S GUIDE TO CLINICAL RESEARCH, ALPHABETICALLY ARRANGED IN SECTIONS. Pp. 149 + xlix. Price 2s. 6d., cloth boards, foolscap 8vo. London: The Clinical Research Association, Ltd., 1914.

The object of this publication is to afford the general practitioner all necessary information for making use of the facilities of the Clinical Research Association in obtaining expert reports of chemical and bacteriological examinations in the diagnosis and treatment of disease. The compilation is the result of the experience for five years of the Editors of the *Journal of Clinical Research*. Their small manual enumerates systematically all the classes of cases in which this research is likely to be of value; and describes minutely the best way in which all necessary material may be obtained and forwarded for examination, with some indications of the probable deductions which may reasonably be expected to be drawn from results forthcoming. The Guide describes the apparatus and technique of procedure necessary, and sets forth the relative importance of different kinds of indications. Some forty sections treat of the best known and most reliable reactions employed in examining the body fluids and tissues—normal and morbid—and also of the analysis of potable water, milk, and other foods, the testing of drugs and for poisons, the comparison of antiseptics, preparation of vaccines, and conduct of various physiological reactions, with a note on veterinary applications. A copious index of some three thousand entries occupies forty-eight of the pages. The sections are also arranged alphabetically, from Blood to Urine and Vaccines. An appendix to the Guide sets out the rates of charges made by the Clinical Research Association for each item of the specific investigations or analyses described in the book, giving the cost (when the prices vary) to members and non-members of the Association. Specially reduced rates are made for hospitals and institutions, and in the treatment of the poor. Suggestions and information are given as to the preservation, packing, and transmission of specimens, and as to the assistance given by the Association in the conduct of post-mortem examinations or legal cases, in radiography, photomicrography, or the making or mounting of pathological specimens. Apart from the main object for which the Guide was compiled, its perusal indicates the alliance between bio-chemistry and physics, and the more obscure regions of disease and therapeutics.

Proceedings of the Royal Society of Medicine.

SUPPLEMENT

(Vol. VIII, No. 7, May, 1915).

NOTES ON BOOKS.

[*The purpose of these "Notes" is neither to praise nor to blame, but merely to draw attention to some of the new books and new editions which have been added to the Society's Library.*—Ed.]

Elements of Pharmacy, Materia Medica, and Therapeutics. By Sir William Whitla, M.A., M.D., LL.D. Tenth edition. Illustrated; pp. xii + 680. Price 9s. net. London: Baillière, Tindall and Cox, 1915.

This, the tenth edition of a work which was originally intended to give the student in a concise form such information as he was left to sift for himself out of two or more larger manuals, has been rendered necessary in consequence of the very numerous changes occasioned by the appearance of a new British Pharmacopœia. In the introduction attention is drawn to the change in the meaning of the term Materia Medica, which formerly embraced the whole of the subjects now divided into the four different departments of Materia Medica, Pharmacy, Pharmacology, and Therapeutics. Before long still further subdivisions will indubitably appear, but for the present it is sufficient to point out that pharmacology has come to be restricted to the science of the action of drugs on a healthy organism, whereas the word therapeutics refers to their application in the treatment of disease. The first part is devoted to Pharmacy and is illustrated by woodcuts, some of which remind us of early days when a knowledge of pill-making was essential to every practitioner of medicine; the second part refers to the administration of medicines, the writing of prescriptions, &c.; the third to Materia Medica (the physical characters of remedies); and the fourth to Pharmacology and Therapeutics; while the non-official preparations, their properties and actions, together with an index of poisons, complete the work.

The Passing of Vesalius. By G. Matheson Cullen, M.D. Illustrated; pp. 31. Reprinted from the *Edinburgh Medical Journal*, October-November, 1914.

The romantic and mysterious story of the closing scenes of the life of Vesalius is dealt with in this pamphlet, which contains a critical analysis of the conflicting contemporary reports of the events leading up to his departure from the Spanish Court, where he had been physician to Philip II, and of his subsequent wanderings until death overtook him, in October, 1564, on the island of Zante. The letter of Languetus to Peucer retailing the news which had been written by an unnamed correspondent in Spain, and upon which the latest biographers of Vesalius have relied, is dismissed as a forgery; and the author concludes from a careful examination of all the evidence that Vesalius went to Jerusalem as a pilgrim (he being probably an orthodox Catholic), in fulfilment of a vow, or at least from some religious motive—perhaps as a mark of thankfulness for his recent recovery from a dangerous illness. Vesalius had determined that his future home should be in Belgium, his native land, towards

which country his wife and daughter turned, after leaving him at Perpignan on his way to Venice. Thence he made his way by sea to Jerusalem, but on the return voyage the vessel encountered tempestuous weather, and on its putting into Zante, Vesalius was put ashore in a dying condition and was subsequently buried by a friendly hand. In the following year a monument was erected to his memory in the church of the Franciscan Convent of St. Mary, every trace of which has long since disappeared. It had been intended to mark the four hundredth anniversary of his birth (1914) by providing another monument which would record the inestimable debt which anatomy must ever owe to him, but while Europe continues to be devastated by fire and sword, this intention must necessarily be laid aside.

ADDRESS ON IMMUNITY AGAINST INFECTIOUS DISEASE, WITH SPECIAL REFERENCE TO ANTI-TYPHOID INOCULATION. By E. J. McWEENEY, M.A., M.D., D.P.H., F.R.C.P.I. Dublin: Sealy, Bryers, and Walker, 1915.

The contents of this pamphlet were delivered as recently as January last by the Professor of Pathology at University College, Dublin, as an address to the Statistical and Social Inquiry Society of Ireland (a non-medical audience), and give an account of the method of protective inoculation against typhoid fever, its underlying principles, and the results obtained by its use. Commencing with an explanation of the theory of immunity and immunisation, the author proceeds to consider the incidence of typhoid on the general population, which in Great Britain has fallen during the last twenty years from 300 to 44 per million in consequence of the ordinary measures of sanitation, including the discovery and isolation of "carrier" cases. After paying a tribute to the labours of Sir Almroth Wright and Sir William Leishman, he describes the methods by which they arrived at the conclusions which enabled them to place the practice of protective inoculation on a sound basis. The plan was tried at the Barming and Richmond (Dublin) Asylum outbreaks with marked success, but received its first extensive application in the Boer War (in which it probably did not receive a fair trial), after which differences of medical opinion arose which induced the War Office to suspend for a while the use of protective treatment. The author proceeds to give the main results reported by Sir William Leishman at the International Congress of Medicine in 1913, according to which, while in 1902 there were 1,012 cases of typhoid in the British Army in India, in 1912 the total number was 118, the reduction being in the main due to the extended employment of anti-typhoid vaccine. The history of the use of the treatment in America is then traced up to March, 1911, when an order was issued making it compulsory upon all those who were to participate in the manœuvres on the Mexican frontier. The results achieved justified the step taken; and in the following June the order was made compulsory upon all recruits. Finally, in September, 1911, compulsion was extended to all persons in the American Army under 45 years of age. Since compulsion has been adopted, typhoid has become practically non-existent in the American Army, and from all sides similar evidence of its efficiency is obtainable; but while in the French Army compulsion has been in force since March, 1914, our own military authorities still falter. The latest report of the Army Sanitary Committee on Enteric Fever in the British Expeditionary Force shows that the total cases number 212, with 22 deaths, of which 212 cases, *173 (81·5 per cent.) and all the deaths* occurred among the uninoculated. Of the remaining 39 cases, 28 had only received one injection or had been inoculated more than two years before, while *only 11 cases occurred among those who were fully vaccinated.*

TEXT-BOOK OF EMBRYOLOGY. By E. W. MACBRIDE, M.A., D.Sc., LL.D., F.R.S. Volume I, Invertebrata. Edited by WALTER HEAPE, M.A., F.R.S. Illustrated; pp. xxxii + 692. Price 25s. London: Macmillan and Co., Ltd., 1914.

This important work is the first of three volumes designed to show the association of the structural development of embryos with broad generalisation of what is known of their physiology. The second volume, by Professor Graham Kerr, will deal with the lower vertebrata, and the third, by Mr. Richard Assheton, with mammals. The scope of this work is indicated by its objects—namely, to place before the reader in a succinct form the best

ascertained results in the field of invertebrate embryology, and to indicate some of the problems which as yet remain unsolved and the best means of attacking them. In working out his scheme the author has chosen the spider as a type of the Arachnida rather than the scorpion, while the Trematoda and Cestoda have been left out of consideration because "it is difficult to obtain a complete series of the stages in the life-history of any one species." A feature of this work which the author has striven to maintain is that of placing before the mind of the student the conviction that the ultimate object of the science of embryology is not solely the acquisition of this special knowledge, but mainly the importance of determining the laws of life which underlie the history of the embryo. The book contains eighteen chapters, and is illustrated by 468 figures in the text. The excellent index occupies twenty-one pages.

A Text-book for Midwives. By John S. Fairbairn, M.A., B.M., B.Ch.Oxon., F.R.C.P.Lond., F.R.C.S.Eng. Illustrated; pp. xi + 317. Price 10s. 6d. net. London: Henry Frowde and Hodder and Stoughton, 1914.

The author of this book, while admitting the fact that he is adding another to the many text-books for the benefit of the midwife, pleads as his excuse that his work has special features, and that it is the outcome of a long experience of the needs and aspirations of those for whom it is intended. He maintains the view that among the more advanced school of practising midwives the thirst for knowledge is insatiable, leading to the use of medical books upon the subject to supply the deficiency. His hope, therefore, is that the scope of this work will be found to be wide enough to meet all the midwife's requirements in this regard. In the first forty-six pages are discussed the subjects of anatomy, physiology, and bacterial infection; then follow parts devoted to pregnancy, labour, abnormal presentations, abnormal labour, the infant, hygiene and disinfection, midwives' duties; an appendix, dealing with note-taking, weights and measures, and drugs; concluding with a glossary of terms not explained in the text, and the index. The book is fully illustrated.

Radiography, X-ray Therapeutics, and Radium Therapy. By Robert Knox, M.D.Edin., M.R.C.S.Eng., L.R.C.P.Lond. Illustrated; pp. xxi + 406. Price 25s. London: A. and C. Black, Ltd., 1915.

This work, though partaking rather of the character of a handbook for those wishing to specialise in radiology, is intended to give as much information as possible in a compact form to students and practitioners on the subjects included in the title. The information given is essentially practical, diagrams are freely used to explain the principles of the various forms of apparatus, so that the beginner may readily understand how best to make use of them. The section on Radiography deals fully with the various modifications of technique, manipulation, and interpretation of the results obtained. Numerous illustrations are provided which will greatly assist the diagnosis of difficult cases. In the section on Radiotherapeutics the various methods of treatment are described in detail and the principles explained. The important question of dosage is dealt with thoroughly. The section on Radium is fairly extensive and is sufficient to give the reader a useful working knowledge of that important agent. The proper selection of cases and the appropriate methods of dosage are clearly explained, while the physics of radium has been fully dealt with by Mr. C. E. S. Phillips, F.R.S.Edin..

The B.D.H. Guide to the British Pharmacopœia, 1914. Diagram; pp. 175. Price 1s. London: The British Drug Houses, Ltd., 1915.

This guide to the new British Pharmacopœia, intended for the pharmaceutical chemist and compounder of medicines, has been compiled with the intention of pointing out the recent alterations, and of directing attention to those chemical substances which have now become official for the first time, and to the new galenical preparations which the pharmacist must henceforth stock; for it is probable that a heavier burden than the making of these

alterations is the discovery of what alterations it is necessary to make. Each article is dealt with alphabetically, and notes are made of the alterations, ostensible and otherwise. A single line at the side indicates that the substance so marked is official for the first time, and a double line that it differs materially in strength or composition from the corresponding preparation of the last Pharmacopœia.

AN INTRODUCTION TO THE STUDY OF ORGANIC CHEMISTRY. By H. T. CLARKE, D.Sc.Lond., F.I.C. Diagrams; pp. viii + 484. Price 6s. 6d. London: Longmans, Green and Co., 1914.

The author states that this text-book has been written in order to cover the ground of the last syllabus of the lower examination in organic chemistry of the Board of Education examinations in science and technology, and also to meet the requirements of candidates for the medical examinations in organic chemistry. In the study of this special subject stress is laid upon the fact that no real knowledge of organic chemistry without laboratory work can be acquired—a point of great importance to the student, inasmuch as the tendency of examination questions is now to demand the inclusion of the description "of all essential practical details." Hence the necessity of a practical training in the science. The first two chapters are expository of the simplest features of the chemistry of the carbon compounds, and introductory to the discussion of the methods of purification and analysis. Then follows the description of the properties of the different classes of organic compounds. Three pages of problems and a full index complete the volume.

ENGLISH MEDICAL WOMEN: GLIMPSES OF THEIR WORK IN PEACE AND WAR. By A. H. BENNETT: with a Preface by STEPHEN PAGET, F.R.C.S. Illustrated; pp. 158. Price 3s. 6d. London: Sir Isaac Pitman and Sons, Ltd., 1915.

This book has been written in order that the history of the entrance of modern women into the medical profession, and the excellent work that has been accomplished by them in England, may be more widely recognised; and as a lay-woman the author claims that seeing the work from the outside enables her to describe details which interest outsiders. After a passing mention of the medical women of early times, we are reminded that the name of the first modern lady doctor, Miss Elizabeth Blackwell, M.D., of the University of Geneva, New York State, appeared in the first Medical Register which was issued in 1859; the first of her sex to procure an English medical qualification being Miss Garrett (afterwards Mrs. Garrett Anderson), who took the L.S.A.(Lond.) in 1865. The story of the long struggle at Edinburgh is then told in detail, and is pursued until we meet with the triumphant statement that every medical licensing and degree-conferring body in Great Britain has now opened its doors to women, except the Universities of Oxford and Cambridge. The author completes the first part of her narrative by tracing the history of medical teaching for women from its commencement in 1877, at the Royal Free Hospital, to which the London School of Medicine for Women has ever since been affiliated. The second part of the volume deals with the work of women doctors in peace and war, gives the history of the foundation and progress of the New Hospital for Women (which commenced as a dispensary in 1866 and to-day occupies a large building in the Euston Road), and takes a cursory survey of the various hospitals for women and children in London and the provinces, the medical staffs of which are composed wholly or in part of qualified lady doctors. Not the least interesting are the chapters dealing with the Women's Hospital Corps working under the French Red Cross, at Claridge's Hotel in Paris, and with the heroism of a similar corps under fire at the bombardment of Antwerp, and concluding with an account of the Medico-Psychological Clinic recently established in London for the practice of psycho-therapy, to which subject the following words of Mr. Stephen Paget's preface refer: "I doubt," says he, "whether Miss Bennett is justified in saying that psycho-therapy is a good opportunity for women's work. In plain English psycho-therapy is the cure of souls; and there are parts of my soul which nothing would induce me to let a woman see—or a man either." But psychopathy does not always permit volition or choice.

THE NEXT GENERATION: A STUDY IN THE PHYSIOLOGY OF INHERITANCE. With Supplement (inset). By FRANCES GULICK JEWETT. Illustrated; pp. xi + 235. Price 3s. 6d. Boston and London: Ginn and Co., 1914.

The purpose of this book is to present in plain language to young people the principles of heredity, environment, and personal development, so that they may understand how cell-life is carried on by a process of evolution from one generation to another. The laws of inheritance as expounded by Mendel, and their application to the reproduction of all plants and animals are lucidly explained, together with the meaning of dominant and recessive characters; with the corollary that as the required characteristics and type of any plant or animal can be obtained at will by human selection, so, without man's aid, Nature herself has arrived at a similar result by natural selection. The process of evolution (Darwin's five-linked chain) is exemplified in the codfish, in which the prodigality of Nature is instanced by its thousands of eggs, few of which get as far as being hatched, while among those which are hatched begins the struggle for existence. As that struggle continues variations appear among the survivors, those only who are fittest to survive becoming parents and transmitting to their descendants those characteristics of superiority which can with advantage be transmitted to future generations. The evidences of evolution are then discussed, and are followed by a description of the principles of heredity, and of Weismann's theory of the non-transmission of acquired characters. The remainder of the book deals with the deleterious influence upon the human organism of alcohol, tobacco, and venereal disease; and after brief mention of the recent gospel of Eugenics, the suggestion is made that in the same way that cretinism has been stamped out in the Valley of Aosta by preventing the marriage of affected persons, so race regeneration should be sought for in the inhibition (by legal means, if necessary) of the marriage of the unfit.

MALAY POISONS AND CHARM CURES. By JOHN D. GIMLETTE, M.R.C.S., L.R.C.P. Pp. viii + 127. Price 3s. 6d. London: J. and A. Churchill, 1915.

This small brochure is based upon the author's eighteen years' service in the Government of the Federated Malay States, ten of which have been spent in Kelantan. It is descriptive of the folk-lore of the Malays, and introduces us to many curious customs and practices of the witch-doctors, or medicine men, skilled in the use of local native medicines. The list of poisons is remarkable in its variety and extent; and yet we learn, from a notable native authority, "that a universal cure for any native poison can be prepared from the wing-bone of a goose, the horn of the wild goat, the spine of the sea-porcupine," and various yet unidentified jungle roots and barks. Goose bones are often used as a medicine, and form part of a mixture employed in the treatment of yaws. On the other hand, the administration of fresh coco-nut water is held in high esteem as an antidote in Malay poisoning. The poisons are derived from many sources—from fish, butter, snails, millipedes, jungle and village plants, powdered glass, sand and quicklime, and bamboo hairs, which mixed with powdered glass cause a chronic pseudo-dysentery. The reason, however, for this armamentarium of noxious products does not seem to be apparent. That they are used with lethal intent is evident; and that some of them are resorted to by burglars to avoid interruption in their nefarious designs is mentioned. But we do not gather from the author why the native Malays should require so many poisons for lethal purposes.

LE TRAITEMENT DES ANÉMIES. By H. VAQUEZ and CH. AUBERTIN. Charts; pp. 96. Price 1 fr. 50. Paris: J. B. Baillière et Fils, 1914.

The subject of anæmia has not attracted the attention it deserves, according to the authors, despite the advances which have been made within recent years in its ætiology and treatment. The time, therefore, they consider, has come for supplying the deficiency, and this small book is the outcome of their belief. Their observations are based upon the division of anæmia into two parts—namely, chloro-anæmia and anæmia of systemic origin, such as that due to cancer, syphilis, tuberculosis, toxæmia, &c. The bulk of the book deals

with the question of treatment, in which iron, arsenic, and arseno-benzol are discussed, as well as the use of serums and other methods, such as transfusion of blood, injections of defibrinated blood, cholesterin and glycerine, radio-therapy, thorium *x*, and splenectomy.

A Key to Health and Long Life. By F. W. D. Mitchell, I.S.O. Pp. 164. Price 3s. 6d. London: C. W. Daniel, Ltd., 1914.

From the preface we learn that the author, "now in his seventieth year, completed, almost a quarter of a century ago, the five years' course prescribed by the Conjoint Board, but owing to the demands of other work could not devote sufficient time to enable him to pass the Final Examination and obtain a medical qualification." The dietetic rules to which he draws attention have, we are told, been tested by him for more than forty years, and "their practical value and accuracy have been proved beyond all possibility of error." The arguments upon which these rules are based are summarised as follows (p. 13): "(1) By far the greater number of common diseases arise from degenerative changes within the body, not from infection or contagion from without; (2) the degenerative changes are the result of the presence in the blood of mal-products of digestion, called lithates, urates, or uric acid compounds; (3) the blood can be kept free from these highly injurious substances by a little self-denial, and by attention to a few simple precautions in regard to digestion, diet, and exercise; (4) the only certain, convenient, and reliable test of healthy digestion, applicable by anyone at any time, is the absence of visible deposits in the water after cooling." The author proceeds to support his argument by frequent quotations from various medical writers, ancient and modern, whereby he arrives at the conclusion that "it is becoming more certain every day that indigestion is the beginning of almost all our ailments—slight, serious, or fatal" (p. 118).

The Mental Health of the School Child: The Psycho-educational Clinic in Relation to Child Welfare. Contributions to a New Science of Orthophrenics and Orthosomatics. By J. E. Wallace Wallin, Ph.D. Pp. xiii + 463. Price 2 dollars. Yale University Press, New Haven, U.S.A., and Humphrey Milford, Oxford University Press, London, 1914.

Most of the chapters of this book are reprints from the various periodicals in which they originally appeared, their publication in volume form being prompted by the widespread interest which is rapidly manifesting itself in the grave social and educational problems which spring from the presence, in every populous community, of large numbers of mentally abnormal children. The object of the author is to show the way in which practical psychologists and expert educationalists may play their part in the movement towards the diagnosis, identification, study, and training of feeble-minded, backward, and mentally abnormal school children. The inspection of these children for the purpose of discovering communicable disease has become a universal custom, though the importance of examination for the detection of physical defects is not yet fully recognised; yet so far as the proper development of the individual is concerned, this is the more necessary of the two. The objects of school life and the interdiction of child labour are similarly directed towards providing children with such mental and bodily training as will eventually increase their future productive capacity; but unless the physical health is cared for the mental machine becomes incapable of assimilating the knowledge offered at school, the expense of which is borne by the State in the expectation that it will be returned in after years in the form of an increased capacity, mental and physical. The author's principal plea is for a further psychological examination, and he suggests, in this reference, the formation of a separate class for mentally deficient school children, by which means the progress of the regular class would not be hindered by backward scholars, and at the same time a sort of clearing-house would be established to which these backward scholars might be sent until, by medical and other treatment, they were rendered more capable of assimilating knowledge, when they would return to the regular class, while the residue upon whom ordinary treatment had no beneficial effect would be passed on to other institutions for the feeble-minded.

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SUPPLEMENT

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NOTES ON BOOKS.

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The Minor Horrors of War. By A. E. Shipley, Sc.D. Pp. 166. Price 1s. 6d. net London: Smith, Elder and Co., 1915.

This book is a reprint of the articles contributed by the author, which appeared in the *British Medical Journal*. For the benefit of those to whom the articles may be unknown, it may be stated that the title, "The Minor Horrors of War," is used neither in a medical nor a surgical sense, but describes the verminous authors of the discomforts which arise from uncleanly surroundings. Among these the louse, the bed-bug, and the flea are first dealt with; secondly, the flour-moth, flies, mites, and ticks. To leeches three chapters are devoted, about which much information is given, the author describing the medicinal leech "as really the friend of man and of the soldier, being a beneficial and not a harmful animal." This testimonial to the well-known *Hirudo medicinalis* is only just in view of the benefits which it is often able to confer. The work is written in a semi-popular style, and, as the author confesses, "in a certain spirit of gaiety"—the same gaiety which, despite depressing times, is unquenchable among, and characteristic of, our troops at the Front, thus setting an example to be followed by those to whom war service is impossible.

Domestic Hygiene for Nurses. With so much of Chemistry and Physics as are necessary to the Reasonable Understanding thereof. By Fred. J. Smith, M.D., F.R.C.P. Second edition. With 20 illustrations; pp. 172. Price 2s. 6d. London; J. and A. Churchill, 1915.

Nurses, assuredly, cannot complain of the amount of literature provided for them with which to supplement their training. This small book, compiled for the benefit of nurses, deals with the elementary facts of hygiene, a knowledge of which forms part of the nursing educational course. The author being the examiner in the subject to the nursing probationers at the London Hospital, the book naturally becomes one of examinational interest for those concerned, and the fact that a second edition has been called for proves that those for whom it is intended have found it useful.

SUPPLEMENT TO THE BRITISH PHARMACEUTICAL CODEX, 1911. INCLUDING ADDITIONS, ALTERATIONS, AND CORRECTIONS. Price 1s. net. London: The Pharmaceutical Press, 1915.

This supplement has been prepared, on the advice of the Scientific Advisory Committee, by the Pharmaceutical Society's Codex Revision Sub-Committee. It contains particulars of important additions and alterations which have become necessary since the publication of the British Pharmaceutical Codex, including new monographs, galenical formulæ, a series of formulæ for test solutions, a list of the chemical equivalents of substances known under proprietary names, alterations in the text of the Codex necessitated by the publication of the British Pharmacopœia, 1914, and a list of corrigenda.

THE LOCALISATION OF BULLETS AND SHELL FRAGMENTS. A RECORD OF PERSONAL EXPERIENCE. By FRANCIS HERNAMAN-JOHNSON, M.D. Pp. 23. Price 1s. net. London: H. K. Lewis, 1915.

This pamphlet is an amplification of two articles published by the author in the *British Medical Journal*. It comprises, not a treatise on localisation, but a record of personal experience. The value of X-ray work, in military practice, depends upon accuracy of localisation and rapidity of results. The author describes in his pages how both these objects can be attained by the methods he has introduced. The definite advantages of these he claims to be: (1) Saving of plates; (2) saving of time; (3) correlation of plate images with skin markings; (4) the skin marks are made by direct vision; (5) employment of a long base line; (6) portability.

DEFECTIVE CHILDREN. By T. N. KELYNACK, M.D. Pp. xvi + 462. Price 7s. 6d. net. London: John Bale, Sons and Danielsson, Ltd., 1915.

The literature devoted to child welfare, stimulated largely by the education service of the country, has become a noticeable feature during recent years. This book is the newest addition to the subject, and has been designed on comprehensive lines. Its object is to provide, in a practical form, information descriptive of the various incidents of defectiveness prevalent in children of the school age period, also to afford helpful advice in the adoption of prophylactic measures where such are likely to prove applicable, as well as to assist in the establishment of ways and means whereby effective steps may be organised for the rectification, arrest, or amelioration of all forms of defect. In furtherance of this scheme each subject dealt with comprises a contribution from a recognised authority, included among which are many well-known names. In addition, the work contains a descriptive account of defective children in other parts of the world, such as Canada, the United States, France, Germany, and Hungary. The scope of the work reveals the extent to which defectiveness prevails among children, and emphasises the need which exists for the adoption of methods to deal with it.

SCHEME FOR DEALING WITH TUBERCULOUS PERSONS IN THE COUNTY OF LONDON: ITS APPLICATION TO OTHER CITIES, WITH SOME OBSERVATIONS ON THE NATIONAL ORGANISATION OF THE CAMPAIGN AGAINST TUBERCULOSIS. By D. BARTY KING, M.A., M.D.Edin., M.R.C.P.Lond. & Ed. With a Foreword by Professor Sir WILLIAM OSLER, Bart., M.D., F.R.C.P., F.R.S. With charts; pp. x + 54. Price 5s. net. London: John Bale, Sons and Danielsson, Ltd., 1915.

The preparation of this scheme has taken the author two years to elaborate. In a foreword, Sir William Osler says of it: "It looks complicated, as does any great piece of machinery, but carefully constructed, managed by good engineers, and oiled by mutual good feeling, it should run smoothly and efficiently." In order fully to grasp the details of this scheme, reference must be made to the work itself. It covers a wide area of interests involved in the tuberculosis question—as, for example, in making provision for the intimate help and co-operation of the voluntary agencies, and in endeavouring to eliminate hospital abuse. In this effort to solve a great problem many original suggestions are put forward.

TEXT-BOOK OF PUBLIC HEALTH. By E. W. HOPE, M.D., D.Sc. Eighth edition, revised and enlarged. With 54 illustrations; pp. x + 267. Price 5s. net. Edinburgh: E. and S. Livingstone, 1915.

This book is a reprint of the section on public health which has hitherto appeared in Husband's "Forensic Medicine," and the republication of this section as a separate volume will, the author believes, prove more serviceable to the student. The scope of the work has been designed to meet the requirements of the medical student or the practitioner reading for the Public Health diploma. The demands of the syllabus, in this regard, are fully provided for in the work.

A TEXT-BOOK OF MEDICAL JURISPRUDENCE AND TOXICOLOGY. By JOHN GLAISTER, M.D., D.P.H.Camb., F.R.S.E. Third edition. With 137 illustrations and 1 coloured plate; pp. xv + 857. Price 15s. net. Edinburgh: E. and S. Livingstone, 1915.

In this, the third edition of the author's work, certain new features have been incorporated: a short description is given of the duties, the statutory powers, and of the penal resolutions of the General Medical Council. Some rearrangement of the chapters has also been made in respect to curtailment and extension, and new illustrative cases have been added. The whole work has been brought up to date, while readier reference to the subjects dealt with has been secured by a more detailed and complete index.

STUDIES IN QUESTIONS RELATING TO EYE-TRAINING. By WILLIAM PHILLIPS, M.A. Pp. 138. Price 1s. 6d. net. London: Blackie and Son, Ltd., 1914.

This small volume is one of the most recent which the publishers have issued in their "Library of Pedagogics." Its object is to discuss whether the efficiency of the eye as an optical instrument can be increased by training or special exercises. The subject is variously dealt with in several chapters, some of which seem, indeed, beyond the range of the scope of the work. Of these, mention may be made of "Peculiarities in the Vision of Certain Forms of Life other than Human"; "Woman's Supposed Special Sensitiveness to Colour Differences"; "The Supposed Acute Sensibility of the Blind and Deaf." On the other hand, "Eye-training and Myopia," an important aspect of the subject, receives a large measure of attention. The author accepts the view that "the kind of myopia which is most prevalent in the schools is not of necessity dangerous or even serious." He claims, however, that no evidence exists to show that any method of eye-training has been successful in reducing the number of myopes or the grade of myopia to which they are subject. The conclusion, generally, at which he arrives is that no special kind of drill or training in schools is necessary for the eyes, provided that the proper hygienic conditions prevail for their use, and, whenever necessary, they receive proper medical attention.

SWANZY'S HANDBOOK OF THE DISEASES OF THE EYE AND THEIR TREATMENT. Edited by LOUIS WERNER, M.B., F.R.C.S.I. Eleventh edition. Illustrated; pp. xvii + 646. Price 12s. 6d. net. London: H. K. Lewis, 1915.

In this new edition, the first which has appeared since the death of Sir Henry Swanzy, the editor has carefully maintained the general plan and character of the book. Complete revision of the text, however, has been carried out, and the various sections brought up to date. This has involved the incorporation of much new matter, without, at the same time, adding much to the increase in the number of pages. The chapter on the pupil, omitted from the last edition, has been restored. The section on nystagmus has been altered and amplified, and now includes a brief account of vestibular nystagmus. The trephine operation for glaucoma has been dealt with in greater detail, and numerous minor improvements and additions have been made. The volume also contains many new illustrations.

WATER SUPPLIES: THEIR PURIFICATION, FILTRATION, AND STERILISATION. By SAMUEL RIDEAL, D.Sc.Lond., and ERIC K. RIDEAL, B.A.Cantab. Illustrations, 24 plates; pp. xii + 274. Price 7s. 6d. net. London: Crosby, Lockwood and Son, 1914.

The science and practice of water purification and testing of drinking water have been largely developed in recent years, especially by experience in the United States, and this book therefore embodies many comparatively new methods—chemical, physical, and bacteriological—bearing upon the ever-changing problems of collection, storage, protection, and distribution. The best examples of the latest results of research applied in actual work in this country and on the continents of Europe and America are described. The first chapter deals with the chemical and physical properties of water which may approximate, practically, to the ideal purity, with a sub-chapter upon saline and medicinal waters, including interesting tables of their radio-activity. According to these latter the waters of Brambach, in Saxony, show a radium content of 2,270 Maché units, which is astonishing as compared with the modest 155 units of the celebrated Gastein, the 126 of Baden-Baden, 38 of Karlsbad, or the 26 of Yellowstone Park, California. The chapter on contaminations by organic matter, soluble or in suspension, living or dead, is illustrated by photomicrographs of typical impurities, with accounts of their origin and behaviour. The chapter discussing sources of supply deals with and compares wells, tube or dug, springs, streams or rivers, rain, and the artificial distillation of sea-water; also the saturation line of ground supply, testing for pollution, and the construction of tanks. A historical review of human settlements as related to natural water supplies prefaces the chapter on distribution; the evolution of modern modes of collection, storage, and delivery being traced. There is a discussion, with a table, of the potentials in volts of electrical loss allowed on tramway systems in various cities, as affecting the destruction of water-pipes, by solution. The method of protection from electrolytic action, either by currents from lighting or power circuit leakages, so that any water system shall be everywhere at a constant potential, is explained. The engineering provisions for storage in the construction of dams and reservoirs, the problems of preliminary purification by various kinds of filtration, natural or chemically assisted sedimentation and coagulation, are fully described. Determination of the "hardness" of waters and methods of softening is discussed, as well as modes of sterilisation—chemical, physical, bio-chemical (or bacteriological), by electrolysis, ozone, and the ultra-violet or mercury vapour electric light, or by a combination of these. The final chapter is devoted to the technique of the various methods of interpreting and checking the result of the treatment of water by analysis—viz., physical tests for temperature, odour, taste, colour, &c. Four appendices contain tables exemplifying the ultimate and detailed analysis of typical potable waters from many well-established municipal supplies, embracing every variety of source; and of sewage effluents, treated and untreated, from tainted streams, sewage farms, and factories. Also analyses of boiler incrustations from different waters, characteristics of water-bearing rocks, and ferro- and plumbo-solvent waters. Each chapter has its own bibliography appended, and there is at the end a short special index to them of the names of authorities, in addition to a general index.

FEVER: ITS THERMOTAXIS AND METABOLISM. By ISAAC OTT, A.M., M.D. Illustrated; pp. 166. Price $1.50. New York: Paul B. Hoeber, 1914.

This book is the substance of three lectures delivered by the author embodying his views upon the subject of fever, matured after forty-five years' study and observation as a practitioner and a physiologist. His conclusion is that fever is a neuro-toxogenic process, in the course of which the toxins stimulate the cells, causing increased metabolic change and continued consumption of energy. He submits that there is no increased production of heat during fever, and affirms that to imagine this is so is "ridiculous." In discussing his views, many references are made to the scientific work of others, dealing with pathological and physiological questions, thus introducing points that have a close bearing upon the clinical aspects of disease, in which fever is present. The first lecture mainly deals with the neural origin of heat production; the second with thermolysis, or heat dissipation; and the third consists of the study of malarial fever and metabolism in relation to fever generally.

LEPER HOUSES AND MEDIÆVAL HOSPITALS: BEING THE FITZPATRICK LECTURES DELIVERED BEFORE THE ROYAL COLLEGE OF PHYSICIANS, LONDON. By CHARLES A. MERCIER, M.D. Pp. 47. Price 1s. net. London: H. K. Lewis, 1915.

These lectures represent an historical sketch of sanatoria, isolation places, and poor-houses, which, under monastic forms, were, from the earliest Christian times, Church and State institutions, and also embody suggestive speculations as to the nature of leprosy. It is well known that houses or settlements for the segregation of lepers were among the first special provisions made for the afflicted; it is not known, however, why, and by what means, that once most prevalent of all diseases became comparatively rare. Dr. Mercier hazards, in the first lecture, the interesting conjecture that as the increase of various manifestations of tuberculosis kept pace with the contemporary diminution of leprosy—so that to-day pulmonary consumption is the main world's scourge—an explanation of the phenomena may possibly be found in the assumption of the gradual change by evolution of a bacillus. The author points out the very similar characteristics of certain strains of the tubercle bacillus—notably the strain of lupus—with strains of the leprous bacillus so far as we know it, and their very similar manifestations, as pointing to a common descent. The author gives reasons for at least entertaining the possibility of the hypothesis that the undoubted simultaneous, spontaneous, and inexplicable disappearance of leprosy, and the spread of tuberculosis may be related. The second lecture describes how, during the centuries, prison-like leper houses, partly almshouses, but mostly of a monastic type, became the many-functioned, privileged, and restricted institutions, which for long partook in quaint combinations of the nature of penitentiaries, dispensaries, or hotels for the traveller; in fact, houses of restraint or refuge like our hospitals and infirmaries to-day. The extraordinary bequests of pious or unscrupulous founders, with their recital of minute and endless detail, atonement for greed, promptings of superstitious fear, and vicarious bequests, vividly resemble the red tape and circumlocution of dead hands our Charity Commissioners still have to disentangle.

MANUAL OF INSTRUCTION FOR THE ROYAL NAVAL SICK BERTH STAFF. Printed under the Authority of His Majesty's Stationery Office. Illustrated; pp. vi + 507. Price 2s., crown 8vo. London: Eyre and Spottiswoode, Ltd., 1914.

This "Manual of Instruction" is a text-book of anatomy, physiology, medicine, surgery, and therapeutics, for the use of probationers and others preparing for examinations for higher ratings; and a compendious reference work for instruction at the Naval Hospitals. With the aid of innumerable diagrammatic illustrations the elements of surgical anatomy, with especial reference to the common fractures or dislocations, and operative procedure, are set forth. The main facts of physiology, and the principal phenomena of pathology in typical diseases are recounted. While the interest and imagination of the trained nurse are stimulated by the rationale of treatment being very fully indicated, he is at every point reminded of the line beyond which the most intelligent "first-aid" should not encroach upon the responsibilities entrusted to the fully qualified practitioner. In text and illustration the "Manual" has drawn upon the St. John's Ambulance Association, the Royal Army Medical Corps Training (1911), and Fleet-Surgeon Gaskell's "First Aid in the Royal Navy," for descriptions of bandaging, stretcher exercises, and the technique of many procedures. There are special chapters upon poisons, asphyxia, anæsthetics, cooking for the sick, post-mortem routine, preparations for general actions and for landing parties, descriptive lists of official medicines and instruments supplied to H.M. ships, with brief indications of the use of the former and the care and preservation of the latter. The "blue-book" price of production, made possible by the assistance of the Comptroller of His Majesty's Stationery Office, accounts for the very low price which places such a volume within the reach of all.

HEALTH FOR THE MIDDLE-AGED. By SEYMOUR TAYLOR, M.D., F.R.C.P. Pp. ix + 103. Price 1s. net, foolscap 8vo. London: Methuen and Co., Ltd., 1915.

This small work is compiled as offering to the non-medical average middle-aged person—of intelligence and in fair health—advice upon every-day matters of hygiene which affect

well-being and fitness to longevity. As "middle-aged" the author classes those between the ages of 49 and 63 (following the London physician Southey), placing "maturity" at the age of 45. In justification of a modern view of these prolonged periods Dr. Taylor epitomises in his first chapter, for the comfort and encouragement of those no longer young, the latest figures derived from actuarial experiences of life insurance companies. One interesting generalisation he points to is that survivors to the age of 65 have a better expectation of life —in some respects—than the average middle-aged; hence the importance of care in the "middle age." The subjects dealt with are: Diet (Alcohol, Tea and Coffee, with Tobacco, having separate special chapters), Clothing, Ventilation, Cleanliness, Sleep, Exercise, Recreation, and Rest. The author does not absolutely condemn alcohol, but urges temperance in all things excepting sleep and fresh air.

CUNNINGHAM'S TEXT-BOOK OF ANATOMY. Edited by ARTHUR ROBINSON, M.D., F.R.C.S.Ed. Fourth edition, revised. Illustrated by 1,124 figures from original drawings, 637 of which are printed in colours, and two plates; pp. xxvii + 1593. Price 31s. 6d. net. London: Henry Frowde and Hodder and Stoughton, 1915.

This new issue of Cunningham's "Anatomy" is a revision of the fourth edition, which was published two years ago. Some alterations have been introduced which the advance of knowledge have necessitated, but apart from these and the general revision of the text, no important change is to be noted, such as distinguished the last edition.

THE ALIMENTARY TRACT: A RADIOGRAPHIC STUDY. By ALFRED E. BARCLAY, M.A., M.D., B.C.Cantab., M.R.C.S., L.R.C.P. With 76 illustrations; pp. xvi + 195. Price 12s. 6d. net. London: Sherratt and Hughes.

This book is the second edition of the author's former work, "The Stomach and Œsophagus." Having, however, expanded his subject to include the whole alimentary tract, the new title was adopted as more expressive of its scope. Taken as a whole, the volume emphasises the value of radiography in the diagnosis of gastric and intra-abdominal lesions—lesions which belong, as the author states, to that branch of medicine, perhaps the most intricate and difficult. Stress is laid upon the diagnostic results by means of fluoroscopy, derived from the observations of the shadows seen on the screen. "It is," admits the author, "a great deal easier to be a radiographer, taking pictures of opaque meals, than a radiologist, who interprets the shadows that he sees." After discussing the question of technique in the examination of patients, the author proceeds, in further chapters, to deal with such subjects as the diagnosis of affections of the œsophagus, the normal stomach, the pathological stomach, gastric ulcer, and hour-glass stomach, the ætiology of gastric and duodenal ulcers, the large and small intestine, &c., and in some concluding observations affirms that "the X-ray method is of some value by itself, but when taken in conjunction with all the other available means of investigation, it becomes the greatest of all aids we possess in the diagnosis of diseases of the walls of the intestinal tract." A tabulation of cases is appended, together with a bibliography, and an index, which might be usefully extended.

FEEBLE-MINDEDNESS: ITS CAUSES AND CONSEQUENCES. By HENRY HERBERT GODDARD, Ph.D. Pp. xii + 599. Price 17s. net. New York: The Macmillan Co., 1914.

This book is intended not only for physicians interested in feeble-mindedness, but also for legislators on the subject. It has been prepared from a mass of laboriously compiled data, and, while it forms a text-book on idiocy, imbecility, and allied social evils, it is mainly devoted to the study of their inheritance. It is interesting to note that the author does not admit hereditary relationship between feeble-mindedness and insanity, but regards the former as a hereditary condition following the Mendelian law; normal-mindedness behaving as a dominant and feeble-mindedness as a recessive character. There are numerous illustrations and heredity charts, one going as far back as six generations, and the whole argument is logically worked out. The volume is well got up.

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A Campaign against Consumption: A Collection of Papers relating to Tuberculosis. By Arthur Ransome, M.D., F.R.C.P., F.R.S. Pp. viii + 268. Price 10s. 6d. net. Cambridge and London: Cambridge University Press, 1915.

Dr. Ransome has arranged for republication in this book twenty-two contributions made by him during the past fifty years upon the subject of phthisis, or public health questions which bear upon the causes and prevention of pulmonary tuberculosis, together with lectures to local associations. The author's interest in an organized attack upon conditions favouring phthisis and its spread dates back to 1860, when, in Salford and Manchester, he initiated a weekly register of new cases of diseases, including consumption. Returns compiled during twelve years from these statistics were, according to Dr. Ransome, incentives to the more complete "Notification of Disease" subsequently established. As the period covers time before and since the isolation of the bacillus by Koch, it should be interesting to study the effect of a capital discovery upon medical thought. The early recognition by Dr. Ransome of the importance of fresh air, ventilation, limitation of infection, and the need for State control, is significant. Among the personal researches are original observations upon the effects of oxygen, ozone, iodoform, cultivation media, and intra-pulmonary injections. The illustrations include a photomicrograph of a cultivation on wall-paper from the breath at ordinary temperature; maps of districts of Manchester and Salford; and many curve charts of statistics bearing upon phthisis-rates compared in different parts of the United Kingdom. There are also appendices of certain meteorological factors from observations since 1867 at Liverpool, Bidston, and Birkenhead; death-rates between 1851 and 1903 in London, and other statistical information. Some almost forgotten therapeutic facts of suggestive interest are again made available in this collection, recording continuously Dr. Ransome's investigations and literary activity during nearly two generations.

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This book is summarized on its title-page as "A Complete History of Twilight Sleep from its beginning in 1903 to its present development in 1915, including its successful use in Great Britain to-day, with all the important medical records of the doctors who have

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employed the method, as well as the personal accounts of mothers who have experienced painless childbirth." The author, deeply impressed by the extent of the suffering frequently involved in childbirth amongst women of to-day, and the probable effect on the birth-rate of the nervous horror of child-bearing produced thereby, undertook a personal investigation of the scopolamine-morphine treatment. In the course of her researches she visited the Frauenklinik at Freiburg, where Drs. Krönig and Gauss have conducted their experiments, and visited, corresponded with, or studied the published opinions of numerous doctors of several nationalities, notably German, British, and American. The book is definitely intended for the general public, and scientific terms are, as far as possible, simplified and explained. It is frankly propagandist in favour of the treatment, but contains the views of opponents as well as of advocates. There is a list of medical references, but a general index in addition would be a convenience to the reader.

Occupational Affections of the Skin. A Brief Account of the Trade Processes and Agents which give rise to them. By R. Prosser White, M.D.Ed., M.R.C.S.Lond. Pp. x + 165. Price 7s. 6d. net. London: H. K. Lewis, 1915.

Occupational affections are of great importance, especially to those practitioners whose lot is cast in the great centres of industrial activity. It has been estimated by careful observers that one-sixth of all cases of skin disease are caused by the occupation of the patient. In this work Dr. Prosser White has made a careful compilation from original articles dealing with eruptions of this type. The book is divided into eight chapters, in which he describes the physical and chemical agents used in the various trades and occupations, and the special characteristics of the eruptions which are produced thereby. The information everywhere is supported by references to the original communications, and these references materially enhance the value of the work. A very full index is appended.

Bedside Hæmatology. An Introduction to the Clinical Study of the So-called Blood Diseases and of Allied Disorders. By Gordon R. Ward, M.D.Lond. Illustrated; pp. 394. Price 15s. net. Philadelphia and London: W. B. Saunders Co., 1914.

The scope of this work embraces, as its title implies, the study of clinical facts by the light of blood examinations in so-called blood diseases and those of allied origin. The author admits a primary difficulty. He affirms that a scientific classification is as yet impossible; hence, for the present, such a classification can only reflect the predilection of an individual author for views and theories to which his bias inclines; nevertheless of his own classification he submits that it is open to all manner of objections—objections based upon a charge of inconsistency from its "very arbitrary" character. The question, however, of this classification difficulty is not one which detracts from the study of so important a subject, in which problems of diagnosis and treatment are primarily concerned. Throughout the volume the author has adopted, in the discussion of the various diseases, a uniform method distinguished by several headings—namely, synonyms, definition, nature, general pathology, allied diseases, ætiology, age and sex, general symptomatology, course, duration, clinical varieties, complications, diagnosis, and treatment—a method which facilitates reference. The index might be, with advantage, expanded, and, for example, oral sepsis and intestinal sepsis, among other subjects mentioned, included.

Methods of Quantitative Organic Analysis; with Diagrams. By P. C. R. Kingscott, D.I.C., A.R.C.Sc., A.I.C., B.Sc.Lond., and R. S. G. Knight, D.I.C., A.R.C.Sc., A.I.C., B.Sc.Lond. Diagrams; pp. xvi + 283. Price 6s. 6d. net. London: Longmans, Green and Co., 1914.

The arrangement in this work, adopted by the authors, is based on that of a series of lectures attended by them during the session 1911-12. The first chapter is devoted to the

determination of molecular weight by physical methods, and includes among the latter those of Victor Meyer, Bleier and Kohn, Dumas, Koffmann, and others. "Ultimate Analysis" forms the subject of the second chapter, and "Estimation of Typical Groups" and "Estimation of some Compounds of Technical Importance" the two succeeding ones. A tabular list of the international atomic weights is given at the commencement of the volume. There are various diagrams in the text illustrative of special apparatus.

FIELD HOSPITAL AND FLYING COLUMN: BEING THE JOURNAL OF AN ENGLISH NURSING SISTER IN BELGIUM AND RUSSIA. By VIOLETTA THURSTAN. Maps; pp. 183. Price 2s. 6d. net. London and New York: G. P. Putnam's Sons, 1915.

To the fact that, after strenuous months in the first lines with a mobile unit in Belgium and Poland, sharing trenches and dug-outs with soldiers regardless of danger, Miss Thurstan was wounded by shrapnel and disabled by pleurisy we owe her lively account; written, in fact, on the spot during an enforced and much resented short rest. The author was commissioned by the St. John Ambulance Committee to take charge of a party of nurses being sent to Belgium. The story opens with a tribute to the warmth of their welcome in Brussels by the now famous Burgomaster Adolphe Max, and their speedy exodus to Charleroi, as a carnage centre when the German force swept in. When the wounded and prisoners were taken back to Germany, the party, with other civilians, though told they would be put over the Dutch frontier, were actually escorted in the slow hospital trains through Cologne, Düsseldorf, Münster, and Hamburg, to Denmark! Permission being obtained to serve in Poland and Russia, the party at once started, *via* Sweden and Lapland, to Petrograd. The war-time conditions observed on a memorable journey are described by the author, who, making common cause with the Russian Sisters at Warsaw, and working in several large hospitals there, was soon in the thick of the terrible fighting at the bombardment of Lodz. The rapid fluctuations of the army fronts, necessitating daily or hourly sudden advances or retreat by the mobile units of the flying ambulance columns, are graphically portrayed. The distinctions between even an emergency or temporary field hospital and the actual flying column, in the nature of their respective requirements, outfit and personnel, are very usefully explained. The real flying unit boasts—like any corps of the army itself—of being ever ready to go anywhere, and do anything, practically living in wagons, motor-cars, slow trains, or afoot on forced marches. In this exacting service the highly trained English nurses shirked no difficulty or danger, and never spared themselves the greatest sacrifice of personal comfort. Whether half-starved or nearly frozen in the reeking verminous pest-houses made to do duty for "hospitals," it is seen that "first-thought" like "first-aid" for the suffering combatant is the supreme consideration. Many pages of this record are painful, horrible reading, though the writer, in confessing to a certain "inexplicable happiness" in her "beloved column on the open road," is not blinded to the wickedness of war. Her book is not a systematic survey of conditions as they have been or might be, being, as she says, noted on odd scraps of paper far from all reference books, when wounded or ill, and amid the turmoil of battle and marching; but in its side-lights on essential facts, and broad, sane outlook, it conveys much of interest and instruction. We are promised a continuation after convalescence from the disability which, soon after last Christmas, interrupted active work.

MY EXPERIENCES AS A GERMAN PRISONER. By L. J. AUSTIN, F.R.C.S. With 12 illustrations; pp. 158. Price 2s. net. London: Andrew Melrose, Ltd.

The author, a member of the British Red Cross Society, who joined the first Belgian unit, recounts in a popular narrative the experiences of himself and his colleague (Dr. Elliott) as prisoners among the Germans during the first five months of the War. The writer and his friend had the misfortune to be captured within their first few days in Belgium, when they ran into the main German army marching on Namur. They soon discovered that "the sanctity of the Red Cross was an ideal of the past," and the author tells how, although in

uniform, unarmed, and provided with all descriptive official passports, papers, &c., they narrowly escaped summary execution. It appears to have been inconceivable to even an educated German army medical officer that men could be really doctors unless they held a certificate of State examination. All their papers were taken from Mr. Austin and Dr. Elliott, never to be restored or seen again; so that, naturally, during many months of subsequent travel and re-transportations from one place of detention to another, without any documentary identifications, they were repeatedly re-examined by courts-martial, and subjected to constant suspicion and indignity. Some weeks of solitary confinement were first spent by Mr. Austin in a small dark cell at Cologne, in an old military prison. Described officially as "spies in some unknown uniform," these Englishmen were watched and fed through trap-doors by silent warders like any dangerous, hardened jail-birds. They were later confined at the special places of internment for officers at Torgau, Burg, and Magdeburg. Early in the War, Mr. Austin tells us, it was confidently reported and widely believed in Germany that there was rebellion in all the Colonies, civil war in Ireland, riot and ruin in London, and a general disruption of our Empire. There is also a just appreciation of the occasional courtesies received at the hands of the enemy. The author was among a few who (selected it appears by lot) were released to be exchanged through Holland, mainly by the instrumentality of the United States authorities. The dozen sketch illustrations, which as free-hand, hasty impressions depict scenes in prison and canteen life, have already appeared in the *Illustrated London News*.

THE MEDICAL ANNUAL. A YEAR BOOK OF TREATMENT AND PRACTITIONER'S INDEX, 1915. (Thirty-third year.) With 149 illustrations and 71 plates; pp. cxx + 959. Price 10s. net. Bristol: John Wright and Sons, Ltd., 1915.

The preparation of this edition of the Annual for the current year involved considerable difficulties, owing to the war. The military engagements of the contributors left but little time for literary labour; their contributions, therefore, were necessarily delayed, and this it is which explains the lateness of the issue of the volume. The main features of the previous editions are maintained, but certain changes may be noticed. For some of these the publication of a new edition of the "British Pharmacopœia" is responsible, and articles have been inserted dealing with its alterations and additions, while the drug references throughout the sections have been unified accordingly. Bearing upon the war are three articles: one on "Modern Naval Surgery," one on "Military Surgery," and the third on "Antiseptics in War, and the Method of their Application." There is a very complete index, and there are numerous plates and illustrations.

A GUIDE TO THE USE OF TUBERCULIN. By ARCHER W. R. COCHRANE, M.B.Lond., F.R.C.S.Eng., and CUTHBERT A. SPRAWSON, M.D., B.S.Lond., M.R.C.P. With charts; pp. vi + 181. Price 5s. net. London: John Bale, Sons and Danielsson, Ltd., 1915.

The aim of the authors has been to provide some plain rules for the practical employment of tuberculin in diagnosis or treatment, for the employment of tuberculin in a given case, and for estimating the first doses and the regulation of subsequent ones. Drs. Cochrane and Sprawson have compared their separate and individual institutional experience, and their joint work in carefully recording the effect of different kinds and strengths of tuberculin as producing local, focal, or general reaction, and upon the course of tubercular disease, are set out in numerous chart diagrams of many cases extending over short and long periods. They regard as indisputable the evidence that tuberculin not only may, but should be employed in nearly all cases, with suitable precautions as to dosage; they are certain it is often curative and need not be harmful. Method and not principle must be blamed for any failure. Very minute doses are enjoined at first in most cases, and observed reactions are not considered necessary. They use the cubic millimetre, or c.mm., for prescribing doses and their strength, instead of decimals of the c.c. or *mil.* as now more properly termed. Dilutions as high as 1 in 500 to 1 in 10,000 are mentioned, and the technique of their

preparation described. Some fourteen varieties of tuberculin in use, or mixtures, are mentioned, of which several are considered of value, and to be used in some cases together; that is, in a certain prescribed order. In discussing the various effects of doses, the authors use the terms "supersensitivity" and "subsensitivity." As to the relative cost of different tuberculins, it is pointed out that perhaps tuberculin, rationally used, is the cheapest of all medicines. There are chapters on "A Working Hypothesis of the Action of Tuberculin," "Pulmonary Tuberculosis in Children," "Contra-indications to Tuberculin Treatment," and "Tuberculosis other than Pulmonary."

THE OPERATIVE TREATMENT OF CHRONIC INTESTINAL STASIS. By Sir W. ARBUTHNOT LANE, Bt., M.S., F.R.C.S. Third edition. Illustrated; pp. 201. Price 10s. 6d. net. London: James Nisbet and Co., Ltd., 1915.

In this new edition of the author's work on "Chronic Constipation" he has changed the title to "Chronic Intestinal Stasis." His thesis, which practical experience has so often endorsed, of the vulnerability of the tissues to intestinal toxæmia is further elaborated in the volume. The importance of the subject receives added weight from his claim that cancer is a result of chronic intestinal stasis. He illustrates the case of a toxic woman. The toxæmia "manifests itself usually as an infection of the mucous membrane and muscle of the uterus, and is called endometritis or metritis. The continued presence of this infection brings about many troublesome consequences, the last link in the chain being here, as elsewhere in the body, cancer. Cancer is the last chapter in the three-volume story of 'Chronic Intestinal Stasis.'" In the section on the treatment adopted by the author, many illustrative cases are given of divers diseases being benefited by the operative methods associated with his name. The volume also contains chapters contributed by Dr. Jordan, Dr. Nathan Mutch, and Sir James Mackenzie, discussing the subject from the radiological, bacteriological, chemical, and clinical aspects respectively. There is no index.

ANIMAL EXPERIMENTATION AND MEDICAL PROGRESS. By WILLIAM WILLIAMS KEEN, M.D., LL.D. With an Introduction by CHARLES W. ELIOT, LL.D. Pp. xxvi + 312. Price 7s. 6d. net. Cambridge, U.S.A.: Houghton Mifflin Co., 1914.

This volume consists of the collection of the author's papers, previously published in various journals, upon the subject of experiments on animals, showing the influence for good which has resulted therefrom upon the progress of medical science. In America the active anti-vivisectionist propaganda are apparently comparable, in force and aggressiveness, with those which prevail in this country, and the author has taken a leading part in opposing them. He uses the word "vivisection," but disapproves of it, as applied to animal experiments generally, inasmuch as it implies "cutting a living animal," whereas only about 6 per cent. of all the experiments upon animals are strictly vivisections. The book contains thirteen papers, preceded by a short introduction by Dr. Charles W. Eliot, of Harvard University, in which the misstatements of the anti-vivisectionists are exposed, and the value of experimental research vindicated. In the author's opinion "the anti-vivisectionists are enemies of animals and of the whole human race," a fact which his volume does much to prove. The Bureau on Protection of Medical Research in America has published a series of twenty-six pamphlets dealing with the subject; the titles of these the author includes in his preface. It is evident, therefore, that the anti-vivisectionists are not allowed to have entirely their own way in America.

THE TUBERCULOSIS NURSE: HER FUNCTION AND HER QUALIFICATIONS. A Handbook for Practical Workers in the Tuberculosis Campaign. By ELLEN N. LA MOTTE, R.N. Introduction by LOUIS HAMMAN, M.D. With two illustrations; pp. xxiii + 292. Price $1.50 net. London and New York: G. P. Putnam's Sons, 1915.

Miss La Motte has brought into a comprehensive survey the varied aspects of sociological, political, and medical questions presented to her during many active years as Nurse-in-chief

of the tuberculosis division of the public health department of a progressive civic community with the prestige of containing the well-known Phipps Foundation and Dispensary of the Johns Hopkins University Hospital. The City of Baltimore was among the first to organize an efficient visiting nurse association, the services of which were so highly appreciated that, from private enterprise, it rapidly passed into a branch of the local government. Through the sentiment created by the Maryland State Tuberculosis Association, an almost independent division of the service was formed to cope with the great white plague, armed with all prophylactic measures. Dr. Hamman, the physician in charge, considers the experience gained justifies a record of the machinery and its results, which the author has embodied in this book. The material is gathered, of ccurse, only locally, under conditions purely American; yet perhaps on a sufficient scale. The lessons frankly, but regretfully, acknowledged are that the tuberculous cannot be isolated in their homes, and cannot be "cured" in or out of sanatoria. But, so much admitted, there may be amelioration, and arrest of the disease, in the individual, with the still higher object of protecting the community. The evidence is that, under continuously maintained conditions, the lesion is very amenable to treatment, so that many patients "recover" so far as to remain comparatively well. The interesting results of statistics so fully compiled in a large settled town in which notification and registration was almost complete, has been, first, that while sanatorium "recovery" is almost invariably followed by relapse if vigilance is relaxed, yet the actual deaths from pulmonary tuberculosis during five years in a practically stationary population fell from 1,400 (in 1909) to 1,129 (in 1913). Miss La Motte finds this "heartbreakingly slow" after so much concentrated strenuous work—but there is reason to believe that the rate had been continuously rising during previous years. The machinery of the nursing service of Baltimore is minutely described. The difference obtaining in poor law as between Great Britain and the United States renders much of the book inapplicable to other countries, but the full details into which the author enters respecting the duties, responsibilities, and rewards of the highly trained tuberculosis nurse apply to the organization of such work everywhere. Not only transatlantic, but other experience (as admitted in the preface), proves that educated women greatly assist in the often thankless task of silently rounding up a tainted flock, and by subtle segregation protect the whole community against itself.

THE CLINICAL ANATOMY OF THE GASTRO-INTESTINAL TRACT. By T. WINGATE TODD, M.B., Ch.B., F.R.C.S.Eng. Illustrated; pp. xii + 264. Price 6s. net. Manchester: University Press. London: Longmans, Green and Co., 1915.

The author of this book was formerly Lecturer on Anatomy in the University of Manchester. He is now Professor of Anatomy in the Western Reserve University, Cleveland, Ohio. Doubtless, however, to show that he has not forgotten his connexion with his old University, he has obtained as his publishers the University Press of Manchester. The contents of the volume embrace the substance of the course of lectures on the alimentary canal, as given in association with his present professorial appointment, and the work has been planned, with the primary intention of providing a handbook for examination purposes, to include anatomical facts, which, so far, have not been incorporated in anatomical text-books. Incidentally, we may note that no attempt has been made to introduce the Basle nomenclature. Of this he says, "only a few carefully guarded terms are used, for the confusion introduced by that premature and ill-considered attempt to revise anatomical nomenclature is as great in America as it is in Britain." The first pages include descriptions of the abdominal wall and the diaphragm; other chapters, out of the eleven of which the book consists, deal with the peritoneal cavity, the features of the gastro-intestinal tract, the stomach, the cæcum, appendix and proximal colon, the distal colon, rectum and anus, with a note on the ileo-pyloric reflex. A full bibliography is added containing 355 references. Reproductions of radiograms are used to illustrate the text.

MATERIA MEDICA AND PHARMACY FOR MEDICAL STUDENTS, WITH AN APPENDIX ON INCOMPATIBILITY. By REGINALD R. BENNETT, B.Sc.Lond., F.I.C. Third edition. Pp. xxii + 248. Price 4s. 6d. net. London: H. K. Lewis, 1915.

The exceedingly concise text-book compiled by the late Lecturer on Pharmacy to University College Hospital, Mr. Bennett, in 1908, has, with the help of the present Lecturer, Mr. C. H. Hampshire, been brought up to date, and revised to conform with the new British Pharmacopœia of 1914. Confined almost entirely to official drugs and their preparations, a distinctive feature of the book is a systematic classification of remedies into three large groups, general, local, and extraneous, with their classes and sub-sections. The briefest possible description is given of each item, omitting secondary or subsidiary applications or effects; but furnishing the student with what is requisite for the examination. Prescription writing is not discussed, and the author explicitly emphasizes the necessity of a simultaneous course of practical pharmacy and dispensing. The appendix on incompatibility only deals with chemical or physical incompatibility in the mixture of medicinal substances — not entering into the discussion of physiological or therapeutic incompatibles. In addition to full tables of dosage of the usual kind, there is a table of the principal preparations of active bases and potent substances arranged in the *order* of their *increasing minimum doses;* commencing thus with atropina, $\frac{1}{200}$ to $\frac{1}{100}$ gr., &c., and ascending, singly or in small classes, to remedies given in the largest single dose. There are other condensed tables of standardized strengths, metric conversions, a short Latin glossary, and a general index. The book is of convenient pocket form.

URGENT SYMPTOMS IN MEDICAL PRACTICE. By ROBERT SAUNDBY, M.D.Edin. Pp. 437. Price 7s. 6d. net. London: Edward Arnold, 1915.

It is stated in the preface that this book is intended to be a handy work of reference for the busy practitioner or student who desires to learn quickly, without the labour and delay of consulting several volumes, the significance of a particular symptom, the indications it affords, and the means whereby it may be relieved. It might be described as a short medical dictionary, chiefly of symptoms, but including also some diseases, and a few special tests and signs. Most stress is laid upon diagnosis, pathology not falling within the scope of the book, whilst treatment is discussed very briefly.

THROAT AND EAR TROUBLES. By MACLEOD YEARSLEY, F.R.C.S. Illustrated; pp. 110. Price 1s. net. London: Methuen and Co., 1915.

This is the first volume of a series of little books intended for general readers, dealing in this instance with the throat, nose, and ear. It contains chapters upon the structure and functions of the organs of voice and hearing, upon enlarged tonsils, adenoids, and other disorders which lead to nasal obstruction, the importance of nasal breathing, the care of the voice, and the causes and means of prevention of deafness. The last chapter exposes the frauds perpetrated upon the public by charlatans and quacks by means of plasters, sprays, ointments, ear-drums, and so-called "electrical" appliances which contain no electricity. The contents are written in plain language, free, so far as is possible, from technical terms, and illustrated by several diagrams, which enable them to be understood by the outside public.

THE MUSCULAR SYSTEM. By HAROLD BURROWS, M.B.Lond., B.S., F.R.C.S. Illustrated; pp. viii + 151. Price 1s. net. London: The Scientific Press, Ltd., 1915.

This booklet contains in small compass the most important features of the anatomy of the skeletal muscles, together with their functions and nerve supply. The classification adopted by the author is unusual, inasmuch as it is based upon function instead of upon anatomy—for instance, the muscles are individually mentioned under the heading of the joint upon which they act. The illustrations are copied from those appearing in "Quain's Anatomy."

NOTES ON THE NERVOUS SYSTEM. By EDWIN L. ASH, M.D.Lond. Illustrated; pp. viii + 98. Price 1s. net. London: The Scientific Press, Ltd., 1915.

The intention of the author has been to provide nurses and students of elementary anatomy and physiology with an epitome of the main lines on which the nervous system is constructed, and of the leading principles governing its functions; and for the special information of nurses a few notes explanatory of the more common diseases of the brain and spinal cord have been included. There are several diagrams.

GUIDE TO MIDWIFERY. By DAVID BERRY HART, M.D., F.R.C.P.E. Second and cheaper edition. Illustrated; pp. xxiv + 765. Price 12s. 6d. net. London: William Heinemann, 1915.

This "Guide to Midwifery," a cheap reprint of the edition published in 1912, is divided into two parts, the first of which, forming by far the larger portion of the volume, contains a succinct account of midwifery from the modern standpoint; the remaining part, entitled "Notes and Discussions," being devoted to chapters elucidating difficult points, and giving summaries of new operations and modern views and theories. Specially interesting among these is the discussion upon "Evolution in Obstetrics," in which the author gives his own conclusions on the relationship to embryology of the theories of Darwin, Weismann, and Mendel. There is a useful bibliography of obstetrical literature, and a large number of illustrations, many of which are original, while others have been reproduced from various atlases and monographs upon the subject. The work is dedicated to James Young Simpson, James Matthews Duncan, and Robert Lawson Tait, at once reminding the reader of the flight of time and of the progress made in the art of midwifery within recent years; and as a foreword the author has selected a quotation from Huxley, in which occurs a sentence which should be committed to memory by every student of medicine: "Nothing is truer than Harvey's dictum, that those who read without acquiring distinct images of the things about which they read, by the help of their own senses, but conceive mere phantoms and idola."

POSOLOGICAL TABLES; APPENDIX ON POISONS; INDEX OF DISEASES AND MEDICINES ARRANGED ACCORDING TO THEIR ACTIONS. By WILLIAM CRAIG, M.D., C.M., F.R.S.E., F.R.C.S.Ed. Fourth edition; pp. 132. Price 1s. Edinburgh: E. and S. Livingstone, 1915.

This epitome, containing in tabular arrangement all the medicines comprised in the British Pharmacopœia, 1914, with their doses, uses, and preparations, is intended for the convenience of the student who, when attending hospital out-patient practice, can find at once in the index of diseases an appropriate remedy for each affection, and in the posological tables the dosage and method of administration. The alterations as compared with the British Pharmacopœia, 1898, the Imperial and metric weights and measures, a list of incompatibles, an appendix on poisons, and a table of the principal medicines arranged according to their therapeutical actions, complete this handy waistcoat-pocket compendium.

TOWN PLANNING: WITH SPECIAL REFERENCE TO THE BIRMINGHAM SCHEMES. By GEORGE CADBURY, jun. Illustrations and maps; pp. xvi + 201. Price 7s. 6d. net. Second impression. London: Longmans, Green and Co., 1915.

Many aspects of the problems of housing and town planning, with which the name of Cadbury is so closely associated, are dealt with by Mr. George Cadbury, jun., in this book, dedicated to his father. The volume is a practical guide to the Act of 1909; and experiences already gained of the interpretation, administration, and limitations of the Act and previous similar ones at Greater Birmingham, Letchworth, and other places, are recorded by Mr. Cadbury in a form useful to medical officers and practitioners (especially those on insurance panels), as well as to local authorities, statesmen, and legislators. By the light of vital statistics now available of the towns and suburbs where, in addition to those of the great Public

Health Act of 1875, the powers granted by town planning enactments have been taken advantage of, it is very striking to compare the figures of infant mortality and the general death-rate with the averages of less favoured places. For though Letchworth, for instance, is a busy manufacturing town, with forty different industries, and a population of 8,000 drawn from congested centres, the infant and total death-rate per 1,000 is respectively only 50·6 and 6·1, against the terrible 145·0 and 14·7 of Burnley, or the 125 and 18 of Liverpool or Shoreditch. It is pointed out that town planning, as the name denotes, is mainly confined to the ordering and construction of main roads, or national highways, and due subordination of minor roads and streets or open places; and the hygienic and economic advantages thus accruing are illustrated. The author quotes the Reports of Commissions which have visited other countries for investigations into town planning. His nine chapters deal with the main principles of modern legislation, the machinery for taking advantage of the present Acts, the relative functions of the local bodies or private adventure and the Local Government Board, the allocation of sites, limitation and distribution of houses to area, gardens, recreation places, parks, allotments, public health and social considerations. There are a number of half-tone pictorial illustrations, maps, plans, and drawings. There are appendices embodying the main governing clauses of the Act of 1909, with certain schedules, and specimen documents passing between municipal and governmental departments in developing the East Birmingham scheme of 1913.

HOSPITAL HANDBOOK IN ENGLISH AND FRENCH. By H. MEUGENS. Pp. 238. Price 1s. net. London: Simpkin, Marshall, Hamilton, Kent and Co., Ltd., 1915.

Though called a hospital handbook, this is in reality a pocket English-French dictionary of those words and phrases which occur in ordinary conversation. It further contains a list with their French equivalents of the common forms of drugs and dressings, and of the weights, measures, and coinage, making it a useful guide for doctors, nurses, dressers, and others who are unfamiliar with the French language.

INFANT MORTALITY. By HUGH T. ASHBY, B.A., M.D., B.C.Camb., M.R.C.P.Lond. Pp. x + 229. Price 10s. 6d. net. Cambridge University Press, 1915.

This book deals with the causes of infantile mortality, and all the various means which have been adopted more recently to reduce the death-rate and raise the standard of infant health. Such causes as poverty, lack of intelligence on the part of the mother, improper feeding, home surroundings, alcohol, and the employment of married women, are fully discussed. The counteracting measures which have been adopted in this country and abroad —such as health visitors, infant welfare centres, infant milk depôts, and day nurseries—are described with great minuteness. Reference is also made to the recent Acts of Parliament, and as to the best means of utilizing them in the conservation of infant health. While the book contains much that is of interest to medical men, it is written more especially for the benefit of lay readers and public health workers, being one of the Cambridge Public Health Series.

A HANDBOOK OF MEDICAL DIAGNOSIS. In four parts. For the use of practitioners and students. By J. C. WILSON, A.M., M.D. Fourth edition. Illustrated by 427 woodcuts and 14 coloured plates; pp. xxii + 1441. Price 25s. net. Philadelphia and London: J. B. Lippincott Company, 1915.

The first part of this large volume is chiefly devoted to medical topography and general rules for examination and note-taking. The second part, occupying more than 300 pages, deals with the methods of examination, by various instruments, in the different systems of the body; and, by chemical or microscopical means, of the blood, urine, sputum and transudates, &c. The third part, of about 200 pages, entitled "Symptoms and Signs," describes very fully all the deviations from health which are to be noted clinically, whether in structure or function, in every part of the body. The fourth part takes up the

remaining 800 pages. It treats of the "Clinical Applications," and it gives us the diagnosis of all the diseases commonly described in a text-book of medicine, in the grouping and order usually employed. Thus more than 200 pages are devoted to the specific infections, numbering forty-two. These are followed by the diseases caused by animal parasites, chronic intoxications, constitutional diseases, diseases of the digestive system, of the respiratory system, and so on. In the account of each disease the writer does not confine himself to diagnosis, but gives generally a full account of the ætiology, symptomatology, complications, and sequelæ. The diagnosis is divided into "direct" and "differential," and is succeeded by a short note on prognosis. In this way as many as 36 pages are given to typhoid fever, 36 to tuberculosis, and 22 to variolous diseases. Indeed, this part of the work differs from a text-book of medicine chiefly in the absence of any section on treatment. The book is very well illustrated by figures in the text, and there are excellent coloured plates of blood corpuscles, of the fundus of the eye as seen with the ophthalmoscope and of malarial parasites.

Amœbiasis and the Dysenteries. By Llewellyn Powell Phillips, M.A., M.D., B.C.Cantab., F.R.C.P.Lond., F.R.C.S.Eng. Pp. xi + 147. Price 6s. 6d. net. London: H. K. Lewis, 1915.

This work, by the Professor of Medicine in the Egyptian Government School of Medicine, Cairo, and Senior Physician to the Kasr-el-Ainy Hospital, is a practical and very readable account of the different forms of dysentery, or of the numerous "dysenteries" caused by different organisms. The term "amœbiasis," of course, implies infection with amœbæ, which may attack not only the intestines, causing amœbic dysentery, but also the liver, lungs, and brain, producing in those organs lesions of a specific kind, which are called abscesses, but whose contents are very different from the pus resulting from more familiar pyogenic organisms. Rarely indeed amœbæ have caused also parotitis, abscess of the spleen, cystitis, and salpingitis. The dysenteries are divided by Dr. Phillips, as is now usual, into those due to protozoa and those due to bacteria. Of the former, that which is due to amœbic infection, or amœbiasis, is the more familiar, and receives the first and most attention in this book. The other protozoa which may give rise to dysentery are the *Balantidium coli*, causing "ciliate dysentery" as a part of balantidiasis; *Lamblia intestinalis*, and other flagellates causing "flagellate dysentery"; *Bilharzia hæmatobia*, which causes quite specific lesions in the large intestine; and the organisms of kala-azar and of malaria. Ciliate, flagellate, and bilharzial dysenteries are adequately described. The last chapter is devoted to the bacillary dysenteries, of which asylum dysentery is one, and in it are described the various bacilli concerned, their toxins and antitoxins, their agglutination characteristics, and their relations to one another. The book ends with a full bibliography, classified under the different headings above indicated.

Sanitation in War. By Major P. S. Lelean, F.R.C.S., D.P.H., R.A.M.C. With an Introduction by Surgeon-General Sir Alfred Keogh, K.C.B., M.D., F.R.C.P. Illustrated; pp. xi + 267. Price 5s. net. London: J. and A. Churchill, 1915.

This is a small khaki-coloured pocket-book with rounded corners, consisting of a course of lectures delivered at the R.A.M.C. College with special reference to the present war, but illustrated by experiences of other campaigns. An enormous amount of information on a great variety of subjects is compressed into the 267 pages. But though the matter is concentrated, the descriptions are clear and the language piquant. The ground traversed may be gathered from the headings of the chapters: I, Physical Fitness for War; II, Anti-typhoid Inoculation; III, The March; IV, Sickness in the Army; V, The Rôle of Insects in War; VI, Medical Organization and Administration in the Field; VII, Field Conservancy; VIII and IX, Water and Water Supplies. But these give little idea of the scope of this small volume—e.g., one is surprised to find a description of the geological formations of Northern France and Belgium. There are many bold and intelligible diagrams, and a good index.

INTERNATIONAL CLINICS: A QUARTERLY OF ILLUSTRATED CLINICAL LECTURES AND ESPECIALLY PREPARED ORIGINAL ARTICLES. Edited by HENRY W. CATTELL, A.M., M.D.Phila., U.S.A. With the Collaboration of CHAS. H. MAYO, M.D.Rochester, and others. Vol. I, Twenty-fifth Series, 1915. Illustrated; pp. ix + 303. Only sold in complete sets of four vols., 35s. net per annum. Philadelphia and London: J. B. Lippincott Company, 1915.

This quarterly is, at all events on this occasion, essentially a record of American opinion and experience. There are indeed two articles from English sources to keep up the international idea, one by Sir William Osler and the other by Dr. Batten, but all the other contributors hail from the United States. There are ten communications under the heading Diagnosis and Treatment. These are followed by reports of visits to medical and surgical clinics, and other clinical matters. There is a discussion of the Medical-Eugenics problem, and a long account of the progress of medicine during the year 1914.

DIABETES MELLITUS. Designed for the use of Practitioners of Medicine. By NELLIS B. FOSTER, M.D. Pp. 243. Price 12s. 6d. Philadelphia and London: J. B. Lippincott Company, 1915.

In this book the author, Assistant Professor of Medicine in Cornell University, has attempted a critical presentation of the state of our knowledge of diabetes mellitus, derived from the extensive literature of the subject. Much of this literature has been published in journals devoted to chemistry or to physiology, which are not commonly read by clinical physicians, and hence may be now usefully brought before them. It presupposes on the part of the reader some acquaintance with the subject, and is directed to the discussion of debateable points, with which the subject bristles, by the light of modern research. It is inevitable that much of the matter is viewed from the chemical standpoint. After a section on normal metabolism, the author deals with glucose in the animal body, experimental glycosuria, and acidosis. Under Symptomatology he devotes a good deal of attention to coma and to theories of its production. There is also a short chapter on renal diabetes, or the occurrence of glycosuria attributed to increased permeability of the kidney, on the grounds that the amount of urinary sugar is not influenced by the carbohydrates ingested, and that there are none of the typical diabetic symptoms. The treatment of diabetes is thoroughly discussed, with its two objects—one, the restoration of the function of utilization of sugar, by limiting the carbohydrate ingestia and lessening the strain upon this function; the other, the avoidance of acidosis, which may result from a too great limitation of the carbohydrates. The means of attaining these two objects and adjusting a sometimes very delicate balance are fully dealt with. The volume ends with a chapter on the identification of the different kinds of saccharine bodies.

THE BIOLOGY AND TREATMENT OF VENEREAL DISEASES, AND THE BIOLOGY OF INFLAMMATION AND ITS RELATIONSHIP TO MALIGNANT DISEASE. By J. E. R. MCDONAGH, F.R.C.S. Plates, 54; pp. viii + 625. Price 25s. London: Harrison and Sons, 1915.

The opening chapters deal with the *Leucocytozoon syphilidis* which, in the author's opinion, is the cause of syphilis—the *Spirochæta pallida* being, in his opinion, merely the adult male of a complicated life-cycle. Considerable proof has been brought forward to substantiate this view, of which the most important is the chemistry of the organism. He points out that the acceptance of the *Leucocytozoon syphilidis* explains all the problems of syphilis which have hitherto remained enigmas; such as, for instance, conceptional syphilis, the origin of tabes, general paralysis of the insane, &c. The next few chapters deal with the technique of the Wassermann reaction, its interpretation, and also its rationale. This is the first attempt to unravel the *modus operandi* of the reaction, which, as everybody knows, has up to the present remained unsolved. The author shows that it is a physical reaction, and not in any way specific. Complement and antibody are considered to be the same

substances in one, which, if correct, will simplify the theory of immunity considerably. In the same chapter an explanation is also given of Abderhalden's test. The clinical aspect of syphilis is next considered, and several new suggestions are advanced, which throw light upon the way in which syphilis attacks the central nervous system. The author provides a rational explanation of the action of chemotherapy, and several suggestions are made as to the lines upon which future research work in this direction should run. The chapters on syphilis end with a full description of its treatment, with the toxic symptoms of salvarsan and neo-salvarsan, and with a detailed description of the various drugs which are in general use. Ulcus molle and its complications are next described; then follows gonorrhœa and its complications, a special chapter being devoted to its treatment by vaccines. The subsidiary venereal diseases are next dealt with, such as Condyloma acuminatum, Molluscum contagiosum, Herpes genitalis, Granuloma inguinale, Induratio penis plastica, and Pediculosis pubis. The three following chapters, which end the first part of the book, are devoted to Sexual Neurasthenia, Venereal Disease and Marriage, and Venereal Disease and Public Health. Owing to the difficulty of distinguishing, under the microscope, syphilitic inflammation from other forms of chronic inflammation, a novel procedure is adopted, with the idea of making histology simpler and at the same time more interesting. The life-history of the cells met with in chronic inflammation are described in detail; the close connexion between chronic inflammation and malignant disease is fully considered, and several new suggestions are advanced upon the subject. The so-called parasites of cancer are shown to be altered nucleoli of the host's cells, behaving pseudo-parasitically, and a distinction is drawn between embryonic activity and malignancy. Although the book contains much pathological work, which is the outcome of the author's research work and therefore new, the clinical matter has in no wise been neglected, as about 100 cases from the author's practice are described in detail. The book is illustrated throughout with several coloured plates, photographs, and drawings.

STEREO-ROENTGENOGRAPHY OF THE ALIMENTARY TRACT. Sections 1, 2, 3, and 4. By JAMES T. CASE, M.D. Price of the entire set of sections, in boxes, $36. Troy, New York: The Southworth Company, 1915.

This is a collection of stereoscopic skiagrams mounted on loose cards arranged in boxes. The skiagrams occupy the width of the card at the bottom, the rest of the card being taken up with explanatory text. The arrangement of loose cards is necessary to enable the skiagrams to be examined in a stereoscope; much of the effect of solidity is lost when stereoscopic views are mounted in books, for in that case they can only be inspected by a very primitive hand stereoscope, and usually with poor illumination. The pictures include examples of a large number of disorders of the alimentary tract, commencing with the œsophagus and working through to the rectum. Although the work consists of separate skiagrams, the explanatory matter is so arranged that the text forms a fairly continuous story; in many instances we are given a list of diagnostic features characteristic of the disease under illustration. The technical aspects of stereo-radiography are dealt with first. Many portions of the alimentary tract are in constant movement, necessitating rapid exposures, and automatic devices for shifting the tube and changing the plate. Stereoscopic radiography is to supplement fluoroscopy, not to supplant it. The author regards the fluorescent screen examination as the more important; the stereoscopic pictures illustrate the fluoroscopic findings, and enhance the observer's power of interpreting what he sees with the fluorescent screen, aided by manipulation. The work is admirably got up, the stereoscopic illustrations being actual photographic prints pasted on to the cards not half-tone blocks. The stereoscopic effect thus obtained is very good, the pictures of the large intestine especially being most striking in the effect of "relief" they give.

On Means for the Prolongation of Life. Founded on a Lecture delivered before the Royal College of Physicians on December 3, 1903. By Sir Hermann Weber, M.D., F.R.C.P. Fourth enlarged edition. Pp. x + 235. Price 4s. 6d. London: John Bale, Sons and Danielsson, Ltd., 1914.

As this is the fourth edition, the work is probably already fairly well known, but in each successive edition it has been considerably enlarged. A short introductory section is followed by one on the Natural Duration of Life. Then come in order sections devoted to: (3) The Mode of Life of Long-lived Persons; (4) The Influence of Heredity; (5) Senile Atrophy and the Cause of Death from Old Age; (6) Action of Exercise on the Heart and Blood-vessels: (7) Digestive Organs and Food; (8) Alcohol; (9) Tea, Coffee, Cocoa; (10) Tobacco; (11) Action of the Bowels; (12) the Nervous System, including the influence of mental occupation, cheerfulness, will-power, &c.; (13) Sleep; (14) the Skin; (15) Importance of the Glandular Organs (thyroid gland, &c.); (16) Prevention of Disease, including the influence of education, clothing, climate, &c. The author has endeavoured to lay stress on the "things which count," and the majority of the factors which favour the attainment of old age tend likewise to make men good citizens, and helpful to others as well as to themselves. The motto on the title-page is: "Work, Moderation, and Contentedness are the main sources of health, happiness, and long life."

Mental Medicine and Nursing. By Robert Howland Chase, A.M., M.D. Illustrated; pp. xv + 244. Price 6s. net. Philadelphia and London: J. B. Lippincott Company, 1914.

The foreword describes this handbook as an introduction to the study of mental disease, originally designed for the use of pupil-nurses attending lectures on this subject, but extended to meet the needs of busy practitioners and students who find the ordinary manuals too complex and diffuse for ready reference. The author's endeavour has been to make it as practical as possible by omitting secondary matters and disputed questions, thus keeping the volume within convenient limits. The first part deals with the mechanism of the central nervous system, and the second gives a description of the mental processes; and while the two following parts are devoted to disturbances of the senses and to the various psychoses, the last gives particulars of the treatment, nursing, and feeding of patients. There is a table of definitions of the terms in common use, and an appendix which contains details of the methods to be adopted in cases of poisoning; and scattered through the volume are photographs of patients showing the facial stigmata of insanity, and some interesting illustrations of the old-time methods of treatment.

Encyclopædia Medica. Edited by J. W. Ballantyne, M.D., C.M., F.R.C.P.E. Vols. I and II (second edition). Illustrated; pp. xv + 744. Price per vol. 20s. net. Edinburgh and London: W. Green and Son, Ltd., 1915.

In this, the second edition of the "Encyclopædia Medica," the general plan of the work and the mode of arrangement which characterized the first issue have been retained, and while all the original articles have been revised, some have been entirely rewritten, and additions have been made under the headings of Acute Abdomen in Adults and Children, Abdominal Section, Acidosis, Acromegaly, Adenoid Post-nasal Growths, Alkalies, Antenatal Pathology and Hygiene, and Asepsis in Midwifery. Although the Basle nomenclature has already been adopted in many schools on the Continent, in America, and the British Colonies, as also in an increasing number of English text-books of anatomy, the general practitioners and specialists of this country are still employing the English terms which have been so long familiar, and for this reason the editor has decided not to alter the nomenclature in the present edition; but it is surmised that, by the time the next one is issued, it may be found desirable to adopt the Basle terminology. Meanwhile a table has been inserted, arranged in three parallel columns, in which the reader can compare the ordinary English name with

the Latin term as fixed by the Basle Commission, and with its suggested English equivalent though as yet there is no authoritative English translation of the Basle Nomina Anatomica. The illustrations have been increased in number and improved in quality, and the whole presents a valuable reference volume.

A Treatise on Materia Medica and Therapeutics, including Pharmacy, Dispensing, Pharmacology, and Administration of Drugs. By Rakhaldas Ghosh, L.M.S.Cal. Univ. Edited by B. H. Deare, Lieut.-Colonel I.M.S., with the assistance of Birendra Nath Ghosh, F.R.F.P.S.Glas. Pp. xii + 698. Price 7s. 6d. Calcutta: Hilton and Co., 1915. London Agents: Simpkin, Marshall Hamilton, Kent and Co., Ltd.

The issue of the British Pharmacopœia, 1914, has been answerable for the publication of new editions of many of the leading works on Materia Medica and Therapeutics, and although only two years have passed since the appearance of the fifth edition of this treatise, the interval has furnished much additional pharmacological knowledge. In this edition the alphabetical arrangement hitherto adopted has been relinquished in favour of the classification of drugs according to their use and effect in medicine; but the need for some other method of ready reference has been met by the provision of an admirable index. Accompanying the particulars of the characters and composition of each drug is a list of its preparations, official and non-official, which is followed by a lucid explanation of its pharmacology and therapeutics, and by hints and cautions to be noticed when prescribing —a novel and particularly welcome addition.

The Pharmaceutical Pocket Book for Practitioners and Students. By John Humphrey, Ph.C., F.J.I. Fifth edition. Pp. 360. Price 1s. 6d. net. London: The Pharmaceutical Press, 1915.

This compendium is divided into four principal sections, comprising: Notes on the Formulæ and Processes given in the British Pharmacopœia, 1914; The Science and Art of Dispensing; The Analysis of Water, Milk, and Urine; and an extremely useful Dictionary of Synonyms and Trade Names. Scattered throughout the volume are various epitomes relating to the sale of poisons, poisons and their antidotes, tables of thermometric equivalents and of the metric and Imperial weights and measures, the materia medica of vegetable and animal origin, doses of official medicaments, and a list of the abbreviations generally used in writing prescriptions. The whole affords in small bulk an easy means of understanding the alterations in the new Pharmacopœia, and a valuable ready reference thereto.

A Compendium of the Pharmacopœias and Formularies (Official and Unofficial) with Practical Aids to Prescribing and Dispensing. By C. J. S. Thompson, Fifth edition. Pp. vi + 398. Price 5s. net. London: John Bale, Sons and Danielsson, Ltd., 1915.

Commencing with a list of new remedies, this "Handy pocket-book of reference for medical practitioners, pharmacists, and students" proceeds to give synopses of the British and each of the Foreign Pharmacopœias, showing the existing differences in their respective formularies. A selection of unofficial and useful formulæ from the British Pharmacopœia Codex, Hospital Pharmacopœias, and other sources, is followed by analytical notes and special tests, the analyses of milk and urine, poisons and their antidotes and a table of synonyms. A list of the medical terms and phrases used in foreign pharmacopœias and prescriptions is an additional feature not met with in the majority of the publications on this subject. Besides the numerous practical aids to prescribing and dispensing, various lists and tables (for instance, an explanation of the terms used in oculists' prescriptions) are interspersed throughout this handy little compendium.

The Royal Society of Medicine.

October 30, 1914.

In the unavoidable absence of the President (Dr. Frederick Taylor) the Chair was taken by Sir Henry Morris, Bt., who, on behalf of the Fellows, welcomed Professor Bose and introduced him to the meeting.

The Action of Drugs on Plants.

By Professor J. C. Bose, C.S.I., C.I.E., M.A., D.Sc.

Presidency College, Calcutta.

It was not till recently that we realized how numerous are the difficulties that confront an investigator into the action of drugs upon the human subject. The medical faculty is amazed at the claims made by another body professing faith in science, who are reported to have made astounding cures without the aid of medicine. This body, hailing from the New World, even counts among its votaries citizens of this country. Sceptics explain away these alleged cures by a theory of auto-suggestion. But in the practice of medicine itself auto-suggestion is not excluded; for among the curative factors we have the personality of the physician, the inherited memory of the medicine man and his magical practices, and the pure effect of drugs as such. This will give us some idea of the great intricacy of the problem; and the only way in which we can evade the almost insuperable difficulties that confront us, is by taking for our experimental subject an organism whose psychic power is so undeveloped as to be incapable of reacting to a suggestion. Such a rigorous condition is amply fulfilled by the plant, for no one will impute an emotional exuberance to a turnip. Results of experiments carried out with plants will therefore give us the pure effect of the chemical agent. Therefore, we shall be on somewhat safer ground if before hazarding a new drug on a patient we examine its potency on an inarticulate and uncomplaining piece of vegetable.

That such expectations are not purely fanciful will become evident when I cite one of our greatest living authorities, whose work has become classical. In his well-known work on medicine, Sir Lauder

Brunton expresses his deliberate conviction that scientific investigations regarding the effects of various drugs on the animal could not be regarded as satisfactory until we succeeded in discovering their effects on living organisms as a whole, including the plant.

It is not necessary here to descant upon the importance of the more universal aspect of the subject as in the investigation by the comparative method. It will, however, be admitted that it is only by the study of the simpler phenomena of irritability in the vegetal organism that we can ever expect to elucidate the more complex physiological reactions in the animal tissues; and in the scientific study of the effect of drugs we should aim to get at the very root of the matter, in discovering the fundamental reactions of drugs on the simplest protoplasmic mechanism of the plant.

Assuming that plant tissues respond to the characteristic action of different drugs, yet the physiological change induced will elude our visual scrutiny. To take an extreme case, we find that it is impossible by mere inspection to distinguish between plant specimens one of which is alive and the other killed. We have then to discover means by which the plant itself is made to reveal its internal condition, and changes in that condition by characteristic signals recorded by it. Our success in devising such a method will enable us to determine whether a given drug causes an excitatory or depressing effect on the plant.

The results obtained with plants might lead us to expect that effects essentially similar would be found in the animal. But this expectation can only be justified if it can be shown that the physiological responses of the plants are in the main similar to those of the animal. This inference, however, runs counter to the prevailing opinion. For ordinary plants, unlike animals, maintain an attitude of passivity under a succession of blows. Animal tissues give electrical signs of irritation; ordinary plants, on the other hand, are supposed not to give any such signs of excitement. The animal possesses a wonderful nervous system by which the organism is put into intimate communication with its different parts and with the environment. On the other hand, all authorities are unanimous in declaring that in a plant admittedly so sensitive as *Mimosa* there is no such thing as nervous impulse. And lastly, certain rhythmic tissues of the animal go on beating incessantly without any apparent cause, this spontaneous activity undergoing very characteristic modification under definite physiological changes. No phenomenon corresponding to this had been suspected in the plant.

I shall have occasion to demonstrate that the assumption of such difference between animal and vegetable organisms is not justified. I shall, on the contrary, show that the phenomena of contractile response in the plant reveal characteristics similar to those of the animal; that even ordinary plants exhibit under excitement a responsive electrical variation of the same sign as in the animal; that excitatory impulses are transmitted through certain conducting tissues of the plant in a manner precisely similar to the nervous impulse in the animal; and that there are rhythmic tissues in the plant which react under various external conditions in a manner just the same as those of the animal.

After demonstrating the similar physiological characteristics in vegetal and animal organisms, I shall next speak of the effects of various stimulating and depressing agents, such as a constant electrical current, various drugs, narcotics and poisons, on the contractile, the conducting and the rhythmic tissues of the plant.

It will further be shown how the normal effect of a drug on the plant is profoundly modified by two other factors. The first of these is the influence of dose or strength of application. The second factor of modification is the change induced in the tissue by the cumulative action of stimulus, in consequence of which the response of the organism undergoes a complete cyclic change. Consideration of these questions will probably throw much light on various anomalies met with in medical practice.

Having now briefly outlined the subject of my discourse, I shall next describe my experimental devices, the methods of investigation, and their results. This somewhat extensive subject I shall treat in the following order:—

(I) Plant Script.
- (1) Mechanical response of plant.
- (2) The Resonant Recorder.
- (3) Electrical response of plant.

(II) Similarities of Mechanical Response in Plant and Animal.
- (1) Additive effect of stimulus.
- (2) Effect of temperature.
- (3) Work performed by contractile tissue.
- (4) Latent period and its variations.
- (5) Diurnal variation of excitability in plants.
- (6) Death-spasm in plants.

(III) Demonstration of Nervous Impulse in Plants.

(1) Excitatory impulse in absence of mechanical disturbance.
(2) Velocity of impulse modified under physiological variation.
(3) Physiological block of nervous impulse.
(4) Confirmatory evidence of electrical investigation.

(IV) Conducting Power of Nerve and its Variation.

(1) Induction of artificial paralysis and its cure.
(2) Canalisation of conducting path.
(3) Control of nerve-conduction.

(V) Similarities between Rhythmic Pulsations in Plant and Animal.

(1) Refractory period.
(2) Effect of ligature.
(3) Effect of temperature.

(VI) Effect of Electrical Current on Plant-response.

(1) Polar reactions on contractile tissue.
(2) Contrasted effect of anode and kathode on pulsating tissues.
(3) Inhibitory effect of transmitted electric stimulation.

(VII) Effect of Chemical Agents on the Response of Contractile Tissue.

(VIII) Effect of Drugs on the Conducting Nerve.

(1) Effect of poison in the abolition of conduction.
(2) The Conductivity Balance.

(IX) Effect of Drugs on the Pulsation of Rhythmic Tissue.

(X) Modifying Influence of Dose.

(XI) The Molecular Cycle.

(I) Plant Script.

As regards the possibility of revealing internal changes in the plant, the only conceivable way of doing so is by the detection and record of the response of the organism to a definite testing shock. If we can find out in the plant the relation between the stimulus and response, we shall be able to determine its state of vitality at the moment. In an excitable

condition the feeblest stimulus will evoke an extraordinarily large response; in a depressed state even a strong stimulus will evoke only a feeble response; and at the onset of death there is an abrupt end of the power to answer at all. Thus by means of testing blows we are able to make the plant itself reveal those invisible internal changes which would otherwise have entirely escaped us.

We may, as we shall see, employ different methods of recording the response of the plant. The most evident is the method in which the answer is given in the form of mechanical movement.

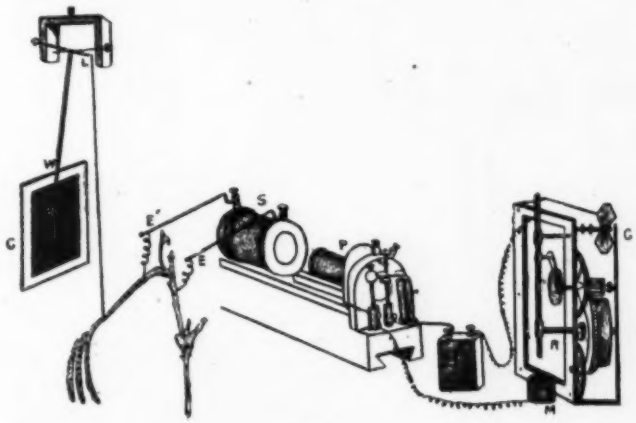

FIG. 1.

Diagrammatic representation of Automatic Plant Recorder. Petiole of *Mimosa*, attached by thread to one arm of lever, L; writing index, W, traces on smoked glass plate, G, the responsive fall and recovery of leaf; P, primary, and S, secondary, of induction coil. Electric shock passes through the plant by electrodes, E, E'; A, accumulator; C, clockwork for regulating duration of tetanising shock. Primary circuit of coil completed by plunging rod, R, dipping into cup of mercury, M.

(1) *Mechanical Response of Plant.*

At the joint in the leaf of the so-called sensitive plant, *Mimosa*, there is a cushion-like mass of tissue known as the pulvinus. Under excitation the parenchyma in the more excitable lower half of the pulvinus undergoes contraction, in consequence of which there is a fall of the leaf. This sudden movement constitutes the mechanical response of the leaf. By the invention of different types of recorders I have succeeded in making the plant itself write an answering script to a

testing stimulus; and in order that the results obtained should not be influenced by any personal factor, arrangements have been made that the plant attached to the recording apparatus should be automatically excited by a stimulus absolutely constant, should make its own responsive record, going through its own period of recovery and repeating the same cycle over again without assistance at any point on the part of the observer (fig. 1).

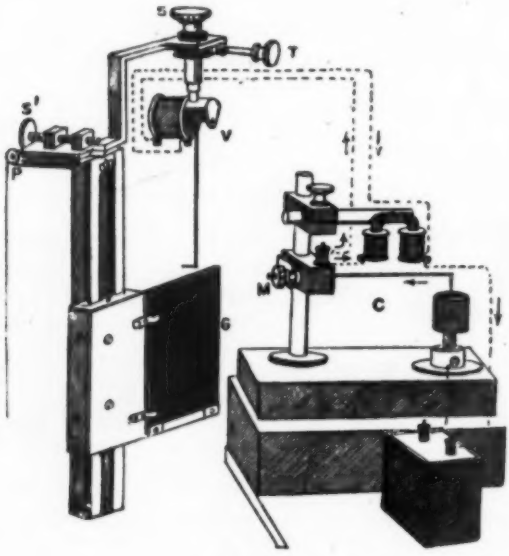

FIG. 2.

Upper part of Resonant Recorder (from a photograph). Thread from clock (not shown) passes over pulley, P, letting down recording plate. S', screw for adjustment of distance of writing-point from recording plate; S, screw for vertical adjustment; T, tangent screw for exact adjustment of plane of movement of recorder, parallel to writing surface; V, axis of writer supported perpendicularly at centre of circular end of magnet; C, reed; M, micrometer screw for adjustment of length of reed.

(2) *The Resonant Recorder.*

In obtaining the actual record of responsive movements in plants we encounter many serious difficulties. In the case of muscle-contraction, the pull exerted is considerable and the friction offered by the recording surface constitutes no essential difficulty. In the case

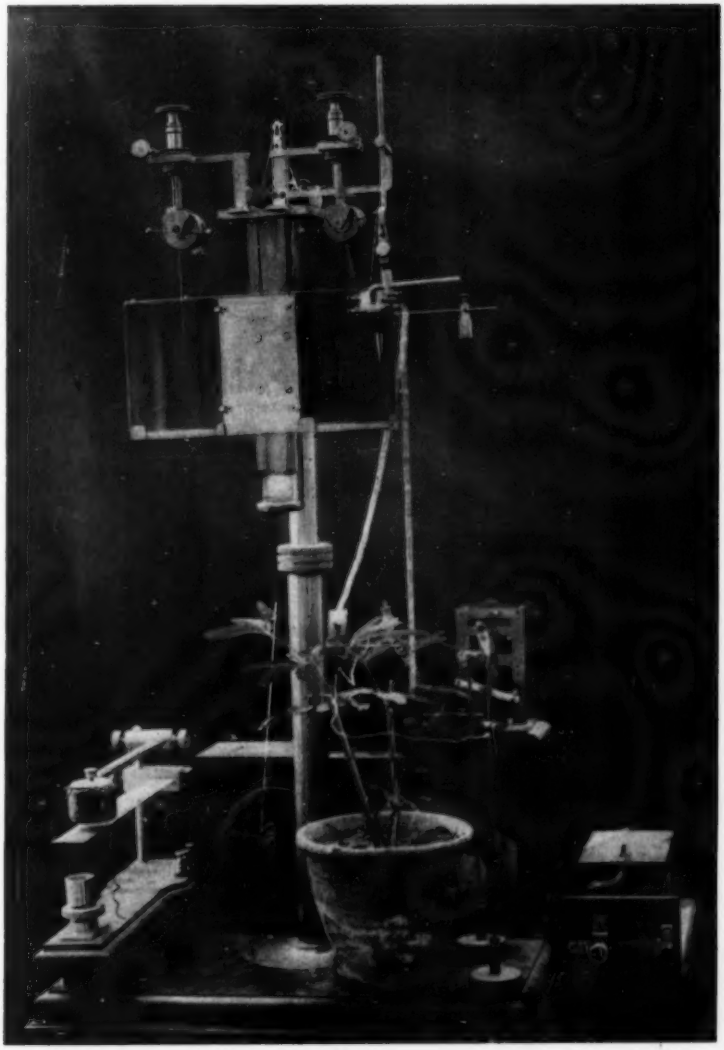

FIG 3.

Photograph of Duplex Resonant Recorder, with plant and accessories.

of plants, however, the pull exerted by the motile organ is relatively feeble, and in the movement of the very small leaflets of *Desmodium gyrans*, or the telegraph plant, for instance, a weight so small as four-hundredths of a gramme is enough to arrest the pulsation of the leaflets. The difficulty could not be removed as long as the writer remained in continuous contact with the writing surface, but I was finally able to overcome it by making an intermittent instead of a continuous contact. The possibility of this lay in rendering the writer tremulous, this being accomplished by an invention depending on the phenomenon of resonance.

The principle of my Resonant Recorder depends on sympathetic vibration. If the strings of two violins are exactly tuned, then a note sounded on one will cause the other to vibrate in sympathy. We may likewise tune the vibrating writer, V, with a reed, C (fig. 2). Suppose the reed and the writer are both tuned to vibrate a hundred times per second. When the reed is sounded the writer will also begin to vibrate in sympathy. In consequence of this the writer will no longer remain in continuous contact with the recording plate, but will deliver a succession of taps a hundred times in a second. The record will therefore consist of a series of dots, the distance between one dot and the next representing one-hundredth part of a second. With other recorders it is possible to measure still shorter intervals. It will now be understood how, by the device of the Resonant Recorder, we not only get rid of the error due to friction, but make the record itself measure time as short as may be desired. The extreme delicacy of this instrument will be understood when by its means it is possible to record a time-interval as short as the thousandth part of a second. Fig. 3 is a photograph of the entire apparatus with accessories.

(3) *Electrical Response of Plant.*

In *Mimosa* the responsive fall of the leaf is due to greater contraction of the lower half of pulvinus. It is evident that if the upper half had been equally excitable the two excitatory contractions would have balanced each other with no resulting movement. It is thus seen that a plant may be excitable and yet may be unable to show it by external movement.

By electrical methods of investigation I have been able to show that every plant, and each organ of every plant, is sensitive, and exhibits the state of excitement by electromotive variation of galvanometric

negativity—that is to say, an electrical change identically the same as that induced in an excited animal tissue.[1] In fig. 4 is shown a series of electrical response in *carrot*, and its gradual arrest under the action of a narcotic.

Thus the two independent methods are at our disposal by which the excitability of a plant tissue and its variations under physiological changes may be detected and accurately recorded.

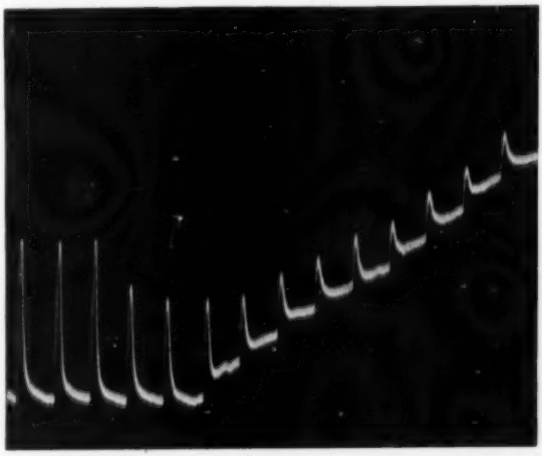

FIG. 4.

Effect of chloroform on electrical response of carrot. The anæsthetic was applied after the third response.

(II) SIMILARITIES OF MECHANICAL RESPONSE IN PLANT AND ANIMAL.

I shall next describe various characteristics of response of contractile plant tissues, from which their remarkable similarity with corresponding response of animal tissue, will become evident.

(1) *Additive Effect of Stimulus.*

In the response of animal tissue it is found that a single stimulus, by itself ineffective, becomes effective upon repetition. The same is found to be the case in plant tissue. Thus, in a particular experiment,

[1] Bose: Friday Evening Discourse, Royal Institution, May 10, 1901. Bose, "Comparative Electro-physiology" (Longmans, Green and Co., 1907).

while an electrical stimulus of intensity 0·1 was singly ineffective, it became effective after being repeated twenty times. It is found, moreover, that this additive effect is, within limits, strictly quantitative.

(2) *Effect of Temperature.*

As in the case of the animal tissue, so also in *Mimosa*, the response is abolished at a sufficiently low temperature. With rise of temperature the amplitude of response is increased and the period of recovery shortened.

(3) *Work performed by Contractile Tissue.*

The effect of load on the response of *Mimosa* is similar to that on the contractile response of muscle. In both, under increasing load,

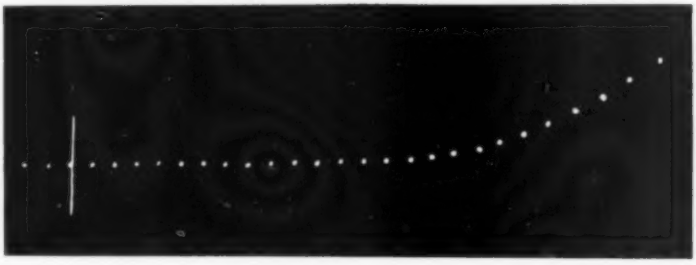

FIG. 5.

Record showing the latent period of *Mimosa*. This recorder vibrates 200 times per second. The time-interval between successive dots is here 0·005 second. The vertical line represents moment of application of stimulus.

the height of response undergoes a progressive diminution, with shortening of the period of recovery. Within limits the amount of work performed by the muscle increases with the load. The same is true of the work performed by the pulvinus of *Mimosa*.

(4) *Latent Period and its Variations.*

The latent period is in general shorter under greater intensity of stimulus, the value becoming constant above a maximal stimulus. The shortest value in the pulvinus of *Mimosa* is 0·06 second. Fig. 5 is

a record giving a value of 0·076 second. A rise of temperature shortens the latent period.

Under fatigue, on the other hand, the latent period is very much prolonged. When excessively tired the plant temporarily loses its power of response. In this condition the plant requires at least half an hour's absolute rest to regain its equanimity. In all these reactions we observe a remarkable parallelism with contraction phenomena in the muscle.

(5) *Diurnal Variation of Excitability in Plants.*

I do not know if any specific investigation has been carried out to ascertain whether the life-activity in the human subject remains

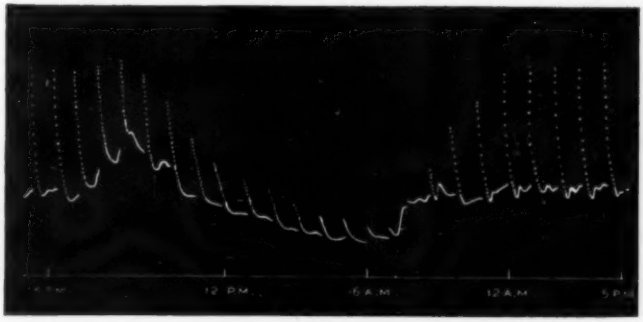

FIG. 6.

Record for twenty-four hours, exhibiting diurnal variation of excitability, commencing at 5 in the afternoon.

uniform during the twenty-four hours, or whether it undergoes any definite periodic variation. I believe it is generally found that vitality is at its lowest ebb in the early hours of the morning. In any case, I find the physiological activity of the plant does not remain uniform, but undergoes a diurnal fluctuation. For carrying out investigations on this subject I made *Mimosa* record its answers to uniform testing shocks repeated every hour of day and night. The amplitude of the answering twitch gave a measure of its activity at each hour. I always found that the excitability of the plant was at its minimum in the early morning, attaining its maximum at noon (fig. 6).

(6) *Death-spasm in Plants.*

The electrical response of galvanometric negativity is abolished on the death of the plant. When the plant is subjected for a time to a temperature of 60° C. the electrical response disappears. This temperature is therefore fatal for most plants. In order to determine the exact death-point I subjected *Mimosa* and various other plants to a gradual rise of temperature. This is attended by a progressive, expansive, or erectile movement; at the critical temperature of 60° C., however, the movement of expansion is suddenly reversed to a spasmodic excitatory contraction. The reversal takes place under standard conditions at or about 60° C.; after this the response of the plant is permanently abolished. The death-record is a V-shaped curve, the sharp point of inversion being the death-point. After death, repetition of this experiment shows no further inversion.

It may be thought that this spasmodic movement is not physiological, but that the contraction is caused by coagulation of protoplasm. The following facts, however, dispose of that supposition. In the event of the contraction being due to coagulation the resulting movement, brought on by general shortening, would be non-discriminative in direction. But in the case of excitatory movement the direction would be discriminative—i.e., determined by the question of the differential excitabilities of the two sides of the tissue. In *Mimosa* it is the lower half of the pulvinus that is more excitable, hence the excitatory contraction of the more irritable lower half determines the spasmodic down-movement at death. Again, if we take a hollow tubular organ, such as the flower peduncle of dandelion or daffodil, and cut it in the form of a spiral, we get a preparation of which the inner or protected side is the more excitable. Hence at the fatal temperature the death-spasm is here exhibited by a greater contraction of the inner surface, resulting in a *curling* movement or tightening of the spiral. But if instead of this we take a tendril that has twined itself round a support, the inside of the spiral, owing to constant irritation by contact, will have been rendered less excitable through fatigue. In this case it is the outer side of the spiral that is relatively more excitable. The death-spasm of the tendril is shown in this case by a movement of sudden *uncurling* — i.e., a movement exactly the opposite of that exhibited by the cut spiral. The difference in the two cases emphasises the excitatory character of the phenomenon. Again, if the spasm observed at the fatal temperature be physiological, the extent of the

movement will depend on the vigour of the specimen; and in conformity with this we find that the death-spasm in younger specimens is far more violent than in old specimens. Moreover, the sudden contraction, or death rigor, in the plant is followed by a post-mortem relaxation. Hence in a complete death-curve we have first a down-curve indicative of expansion; then a sudden notch or inverted up-curve, exhibiting spasmodic contraction; and finally another down-curve showing post-mortem relaxation, the whole curve being like an inverted **N.** It is found, as stated before, that the size of this notch, indicative of death-throe, depends on the vigour of the plant. With a young specimen it is very large, and becomes smaller and smaller with advancing age. With extreme old age the notch almost vanishes, and life passes imperceptibly into death.

That this spasmodic contraction is a physiological phenomenon is further seen from the fact that the death-point, as determined from the inversion of the curve, is lowered under physiological depression. Thus, fatigue will lower it to an extent depending upon the degree of fatigue. In a certain instance the death-point, owing to the above cause, was lowered from the normal 60° C. to 37° C. Previous administration of dilute poison lowered the death-point in another case by 18° C.

Finally, I have shown that all excitatory reactions have as their concomitant a sudden electrical change, of a definite sign; and it is very significant that at the critical temperature of 60° C. there occurs a sudden electrical discharge in the plant, the direction of the current being determined by the differential excitabilities of the tissue.

(III) Demonstration of Nervous Impulse in Plants.

It has been hitherto supposed that in *Mimosa* the impulse caused by irritation is merely hydro-mechanical, and quite different from the nervous impulse in the animal. According to the hydro-mechanical theory, the application of mechanical stimulus is supposed to squeeze the tissue, in consequence of which the water thus forced out delivers a mechanical blow to the motile organ of the plant. This mechanical theory was accepted in view of the anæsthetic experiment of Pfeffer, who, applying chloroform to the *surface* of the stem, found that this did not arrest the impulse. A little reflection will, however, show that under the particular conditions of the experiment the conducting tissue in the interior could not have been affected by the narcotic; the task being, in fact, as difficult as narcotising a nerve-trunk lying between muscles by application of chloroform to the skin outside.

We may apply several crucial tests to decide the question as to whether the impulse in the plant is mechanical or physiological:—

(1) The impulse could not be mechanical, if excitation can be initiated and propagated without any physical disturbance.

(2) The impulse must be physiological, or of a nervous character, if it can be shown that physiological changes induce appropriate variation in the velocity of transmission of the impulse.

(3) If the impulse is arrested by various physiological blocks, then it must be excitatory or of a nervous character.[1]

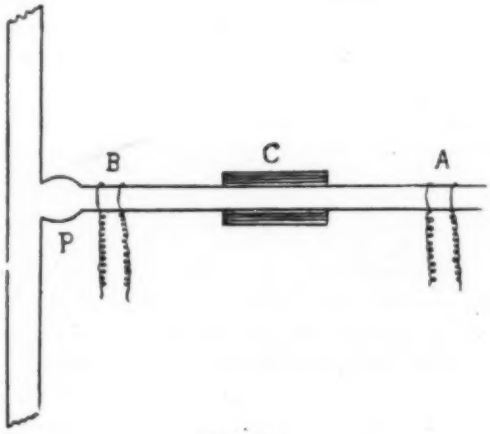

FIG. 7.

Experimental arrangement for determination of velocity of transmission and its variation. Record is first taken when stimulus is applied near the pulvinus at B (latent period) and then at a distant point on the leaf-stalk at A. Difference of two gives time for transmission from A to B. The band of cloth, C, is for local application of warmth, cold, anæsthetics, and poison.

(1) *Excitatory Impulse in Absence of Mechanical Disturbance.*

I have shown elsewhere that excitation takes place in the plant under the polar action of an electrical current, in the complete absence of any mechanical disturbance. This is realised when we find that in certain plants an excitatory impulse is initiated and transmitted by the action of a current which is so feeble as not to be perceived even by the very sensitive human tongue.

[1] For a more detailed account see Bose, "An Automatic Method for the Investigation of Velocity of Transmission of Excitation in *Mimosa*," *Phil. Trans. Roy. Soc.*, Series B, 1914, cciv, pp. 63-97; Bose, "Researches on Irritability of Plants" (Longmans, Green and Co., 1913).

(2) *Velocity of Impulse modified under Physiological Variation.*

The experimental method employed to determine whether any physiological change induces variation in the speed of transmission is seen in fig. 7.

Among the favourable agents which have a marked effect on the nervous impulse of the animal is the influence of temperature. Hence we may devise a decisive experiment to discriminate between the theories of mechanical and nervous transmission in the plant. Temperature has no effect on mechanical propagation, whereas a moderate variation of it profoundly affects nervous transmission. The result given in fig. 8 is quite conclusive as regards the excitatory character of the impulse in plants. It is seen that with rising temperature the time required

FIG. 8.

Effect of rising temperature in enhancing velocity of transmission. The three records from below upwards are for temperatures 22° C., 28° C., and 31° C. respectively. Successive dots represent intervals of 0·1 second.

for transmission through the same distance is continuously reduced. In the present case the velocity is seen to be more than doubled by a rise of temperature through 9° C.

The velocity of transmission of 30 mm. per second in *Mimosa* is of the same order as the speed of nervous impulse in some of the lower animals. This is seen in the fact that the velocity in the nerve of the slug is 125 mm. and in *Anodon* only 10 mm. per second.

(3) *Physiological Block of Nervous Impulse.*

As in the case of the animal, so also in the case of the plant, the excitatory impulse may be arrested by the action of an electrotonic

block. As long as the current is maintained, so long is the impulse arrested; on the cessation of the blocking current, however, the conducting power is immediately restored. Local application of poison is found to arrest permanently the excitatory impulse through the poisoned tract.

(4) *Confirmatory Evidence of Electrical Investigation.*

Another distinct line of investigation independently supports these conclusions. I have shown that the excitatory change in the plant is accompanied by a concomitant electrical change of galvanometric negativity. Electrical investigation carried on with certain isolated strands of conducting tissue of the plants shows that this excitatory electrical impulse is transmitted to a distance along them.

(IV) Conducting Power of Nerve and its Variation.

We have seen how the physiological characteristics of the excitatory impulse in the plant are similar to those of nervous impulse in the animal. Under certain conditions the animal nerve undergoes changes leading to paralysis. In such a case a cure may sometimes be effected. The problem here is to impart a better conducting power to an ineffectively conducting tissue. This power of conduction or its absence are ultimately dependent on obscure molecular modifications. Discovery of parallel phenomena in the plant will undoubtedly prove of great importance.

(1) *Induction of Artificial Paralysis and its Cure.*

An interesting experiment relates to the artificial induction of temporary paralysis. When localised cooling is applied to a part of the petiole of *Mimosa*, the conduction of excitation through that portion becomes greatly delayed, till with sufficient cooling there is an actual block to the transmission of excitation. Thus it is possible by applying a fragment of ice to cause local paralysis of the conducting power of the petiole, which persists for over an hour, even after restoration of the tissues to the normal temperature. It is extremely suggestive, that I was able under these conditions quickly to restore the conducting power by application of electrical shocks of moderate intensity to the paralysed region. Too strong a shock was, however, found to be highly detrimental.

(2) *Canalisation of Conducting Path.*

In plant experiments I find a very significant result as regards the power of stimulus to fashion its own conducting path. Thus a plant carefully protected under glass from the stimulating buffets of the elements looks sleek and flourishing, yet is in reality flabby. Its conducting power is found to be in abeyance, though the motile organ exhibits its normal power of contraction. Anatomically the conducting elements are present, but from want of use they remain functionally inactive. Now in this condition it is very interesting to watch the growth of conducting power under the influence of stimulating blows. There is at first no transmission; after a time excitatory impulse begins to be initiated. Continued stimulation enhances the

FIG. 9.

Canalisation of conducting path by stimulus. Sluggish conducting power seen in lowest record. The next record shows enhancement of conducting power in consequence of previous stimulation. The uppermost record shows attainment of maximum power of conduction.

conducting power to a maximum. The concluding part of this process is illustrated in the records given in fig. 9.

(3) *Control of Nerve-conduction.*

What is the change of the tissue which brings on paralysis? What is the molecular condition which confers conducting power on a nerve? These are very obscure problems, and any investigation calculated to throw light on the subject will undoubtedly prove of the highest importance not only in theory but also in practice.

The nerve may have been rendered abnormal in two different ways.

In one case it may have become extremely sluggish in transmitting an impulse. In the other case it may have become so hypersensitive as to transmit the feeblest excitation with intolerable intensity. In restoring the nerve to a normal condition, we want to augment the conducting power in one case or arrest it in the other.

A man who constantly uses the telephone has it in his power, by a simple process of switching on and off, to keep the circuit open or closed to the calls he receives, according as the message is pleasant or unpleasant. Can he similarly have the same control over the conducting system which exists within himself? Is it possible for him to augment or inhibit the nervous messages?

The phenomenon of excitation may be regarded as a process of molecular upset caused by stimulus, and the transmission of excitation as the propagation of the molecular disturbance. The phenomenon of molecular upset we may simply picture by means of a row of standing books. A certain intensity of blow applied, say, to the book on the extreme right would cause it to fall to the left, hitting its neighbours and causing them to topple over in succession. If the books have previously been slightly tilted towards the left, a disposition would have been given to them which, by facilitating the fall, would accelerate the speed of transmission. Conversely, an opposite disposition would retard or arrest the movement. Thus by means of a directive or polar force we may induce a molecular predisposition which would enhance or retard the speed of the disturbance according to the directive action, positive or negative, of the polar force. It may thus be possible to discover some polar force which, by inducing characteristic molecular dispositions, would enhance or retard the conduction in a nerve.

So much for theory; its value must be judged by practical results. It may be briefly stated here that, acting on the principle that has been described, I have been successful in inducing at will and by turns two opposite molecular dispositions in the conducting tissue of the plant. When the polar force was maintained in a positive direction, the speed of the excitatory impulse was enhanced in a remarkable manner. The nervous impulse could, on the other hand, be increasingly retarded, and finally arrested, by reversing the direction of the force and increasing its intensity. These *supra* or *a*-conducting states were maintained as long as the nerve was subjected to the action of the given force.[1]

[1] The detailed account of this investigation has recently been communicated to the Royal Society.

I have referred to the conducting tissue of the plant as a *nerve*. The use of this term has, I think, been justified by the remarkable similarities of reactions between the conducting tissues of the plant and animal under varied conditions. Perhaps the crucial test of a theory may lie in the power which it gives of predicting unknown phenomena, the predictions being afterwards fully verified. Believing in the identity of characteristics of plant and animal nerves, I applied the same polar forces which I found to be so effective in my plant experiments to the nerve of the frog; and it was a matter of intense gratification to me to find that by employing the same methods I could exalt or inhibit at will the conducting power of the experimental nerve. The importance of this investigation must be obvious to all. Its success further proves the importance of physiological investigation on plants in elucidating intricate problems of animal physiology.

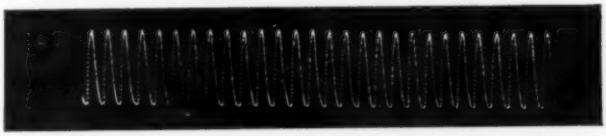

FIG. 10.

Record of automatic pulsations in *Desmodium gyrans*.

(V) SIMILARITIES BETWEEN RHYTHMIC PULSATIONS IN PLANT AND ANIMAL.

In *Desmodium gyrans*, or the telegraph plant, the small lateral leaflets exhibit automatic pulsations. I find that the characteristics of the rhythmic tissues in the plant are surprisingly similar to those of the cardiac tissue in the animal. The down-movement of the leaflet is quicker and corresponds to the systolic movement of the heart. The maximum rate of this down movement is 0·9 mm. per second. The diastolic or up movement is much slower, its maximum rate being 0·56 mm. per second. The pulsating activity of the detached heart of a frog can be maintained for long periods by subjecting it to intercardiac pressure. Similarly the activity of the detached leaflet of *Desmodium* can be renewed by the application of internal hydrostatic pressure, after which the pulsation can be maintained uniform for many hours (fig. 10).

(1) *Refractory Period.*

The cardiac tissue of the animal has a long refractory period. The tissue takes no account of the stimulus which falls within the refractory period. This is also characteristic of the response of the rhythmic tissue of *Desmodium*. Rhythmic tissues, animal and vegetable alike, are incapable of tetanus. The pulsating leaflet of *Desmodium*, like the pulsating heart, is more susceptible to excitation at diastole than at systole. An extra pulsation is induced in both by an induction shock, applied during the diastolic phase.

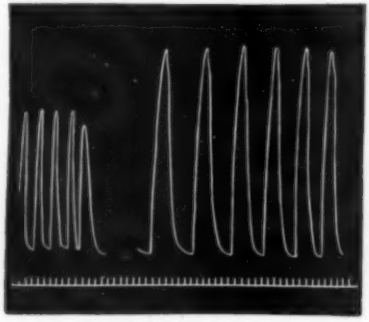

FIG. 11.

Effect of lowering of temperature in producing increase of amplitude and decrease of frequency in pulsation of frog's heart. Record to left, normal pulsations; record to right, effect of lowered temperature (Brodie).

(2) *Effect of Ligature.*

By the application of Stannius's ligature, the pulsation of the heart is arrested at diastole. A similar arrest at diastole is found to take place in the pulsation of *Desmodium* by the application of a ligature immediately below the motile organ. The arrest takes place either at once or after one or two vigorous beats. Similar effects are also obtained by making a cut, after suitably supporting the leaflet. While the leaflet is in the condition of this arrest, it is often possible to renew the pulsation by the stimulus of an electrical shock.

(3) *Effect of Temperature.*

The effect of lowering of temperature on the rhythmic pulsation of *Desmodium* is similar to that on the pulsation of a frog's heart.

Lowering of temperature enhances the amplitude, but reduces the frequency of pulsation of both. A rise of temperature, on the other hand, causes enhanced frequency and diminished amplitude of pulsation (figs. 11, 12).

We have seen the extraordinary similarities of physiological reaction in the contractile, the conducting, and the rhythmic tissues of plant and animal. We shall now take up the reactions of the plant under medical treatment. This latter includes the application of electricity and drugs; we shall therefore consider in some detail the stimulating or depressing effects induced by an electrical current and the stimulating, depressing, narcotic and poisonous effects of various drugs on the plant.

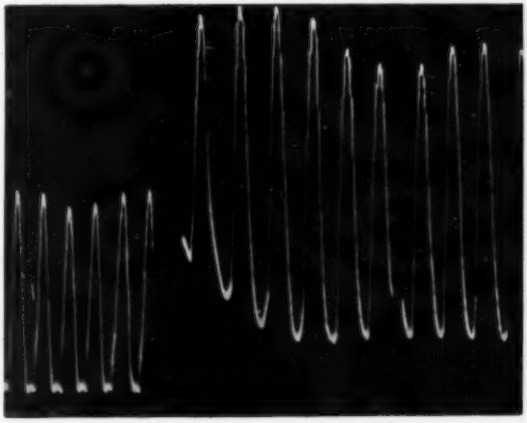

FIG. 12.

Effect of lowering of temperature on pulsation of *Desmodium*. Record to left, normal; record to right, effect of lowered temperature.

(VI) EFFECT OF ELECTRICAL CURRENT ON PLANT-RESPONSE.

The sensitiveness of some plants to the stimulus of an electrical current is extraordinarily high. The human tongue is known to be an extremely sensitive detector of an electrical current, the tongue of an average European detecting a current as low as 6 micro-amperes. But we must bow down to the superior perceptive power of the plant, which in the case of *Biophytum*, for example, is ten times more sensitive than the European!

(1) *Polar Reactions on Contractile Tissue.*

As regards the action of constant current in inducing excitation of the contractile plant-tissue, I find that with feeble current, it is the kathodic point which excites at the make and not at the break of the current; the anode excites at neither make nor break. With current of moderate intensity, the kathode still excites at make and not at break. The anode, however, now induces excitation at the break but not at the make. In all these we have a series of reactions which are identical with those which take place in the contractile animal tissue.

(2) *Contrasted Effect of Anode and Kathode on Pulsating Tissues.*

Taking the case of rhythmic tissues in the animal, the point of application of anode on a beating heart induces an expansion. The effect of the kathode would be the opposite.

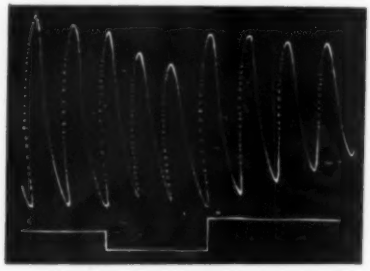

FIG. 13.

Alternate effects of anode and kathode in diminishing systolic contraction and diastolic expansion. Continuous line below record indicates duration of application of current. Line below normal represents application of kathode; line above, application of anode.

Similar effects are also observed in the pulsating leaflets of the telegraph plant. Thus, the application of anode, inducing expansion, tends to oppose the contraction at the systolic phase. The effect is a diminution of contraction. In the record shown in fig. 13 the up-movement represents contraction and the down-movement expansion. The diminution of contraction under anode thus appears in the record as progressive diminution of heights of responses. The application of kathode, on the other hand, inducing contraction, opposes the diastolic

expansion; the amplitude of pulsations is seen progressively reduced with continuously diminishing relaxations, the base-line being shifted in consequence.

(3) *Inhibitory Effect of Transmitted Electric Stimulation.*

The pulsation of the beating heart may be inhibited by the stimulation of the vagus nerve. The rhythmic pulsation of *Desmodium* leaflets may similarly be inhibited by applying electrical stimulation at some distance from the pulsating organ. This is seen in fig. 14, where the inhibitory effect of transmitted excitation is seen to diminish the normal amplitude of pulsation. On the cessation of excitation the pulsations are seen gradually to regain their normal amplitude.

FIG. 14.

Inhibitory effect of transmitted excitation on the pulsation of leaflet of *Desmodium*. Line below indicates duration of transmitted excitation. Note the gradual removal of inhibitory effect on cessation of stimulation.

(VII) EFFECT OF CHEMICAL AGENTS ON THE RESPONSE OF CONTRACTILE TISSUE.

For this investigation a series of uniform responses is first obtained under uniform stimuli. After the application of the given agent, another series of responses is once more obtained under the same stimuli as before. The variation of amplitude of response then gives an indication of the excitatory or depressing action of the agent. The plant is intensely susceptible to the impurities present in the air. The vitiated air of the town has a very depressing effect. According to popular science, what is death to the animal is supposed to be life for the plant; for does it not flourish in the deadly atmosphere of carbonic acid gas? The record (fig. 15) shows that, instead of flourishing, the plant gets suffocated just like a human being. Note the gasp

of relief when fresh air is introduced. Only in the presence of sunlight is this effect modified by photosynthesis. In contrast to the effect of carbonic acid, ozone renders the plant highly excitable. Sulphuretted hydrogen, even in small quantities, is fatal to the plant. Chloroform acts as a strong narcotic, inducing a rapid abolition of excitability. The ludicrously unsteady gait of the response of the plant (fig. 16) under alcohol could be effectively exploited in a temperance lecture! The record (fig. 17) is in the nature of an anticlimax, where the plant has drunk (pure water!) not wisely but too well. The gorged plant is seen to have lost all power of movement. I was, however, able to restore the plant to normal condition by extracting the excess of liquid by application of glycerine.

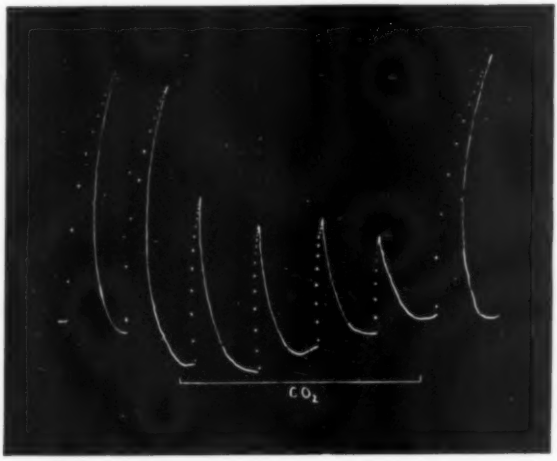

FIG. 15.

Effect of carbonic acid gas.

(VIII) EFFECT OF DRUGS ON THE CONDUCTING NERVE.

I have already described how the variation of conducting power in *Mimosa* is obtained from the automatic records of velocity of transmission of excitation. The arrival of excitation here is signalled by the sudden fall of the leaf. Investigation by method of mechanical response is possible in the case of the so-called sensitive plants. For ordinary plants the motile indicator is not available and an electrical method, to be presently described, has to be employed in such a case.

(1) *Effect of Poison in the Abolition of Conduction.*

Below I give a record which exhibits the effect of poisonous reagents in inducing retardation and subsequent abolition of the conducting

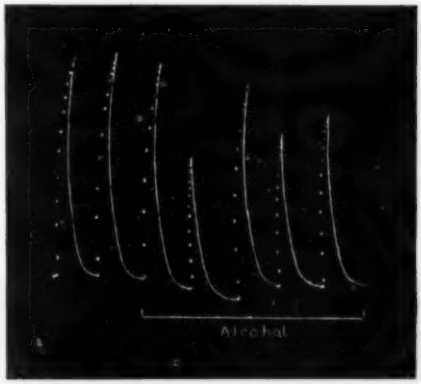

FIG. 16.

Effect of vapour of alcohol.

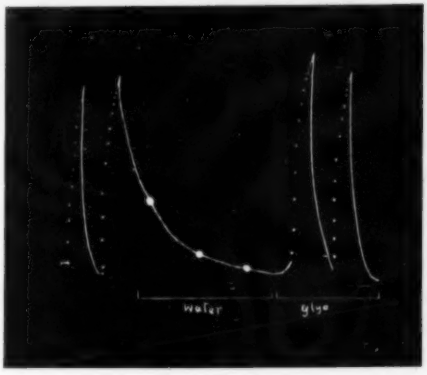

FIG. 17.

Abolition of motile excitability by excessive absorption of water, and subsequent restoration by withdrawal of excess.

power. In the experiments, the record of which is given in fig. 18, copper sulphate solution was applied locally on a portion of conducting petiole, 10 mm. in breadth. It must be remembered that a certain

time must elapse before the toxic agents will get access to the conducting tissue in the interior by absorption. The effect of the toxic agent will thus be increasingly effective with time. Record (1) in the figure shows the normal record for transmission of excitation to a distance of 30 mm., the successive dots representing intervals of 0·1 second. Record (2) was taken after twenty minutes' application of the copper sulphate; the transmission period is seen to be prolonged, indicating growing depression of conductivity. Record (3) was taken forty minutes after the application. The transmitted effect is seen to be completely blocked by the action of the poison. In order to show that the absence of response was due not to the abolition of motile excitability of pulvinus, but to the block of conductivity in the petiole,

FIG. 18.

Effect of copper sulphate solution in the retardation and final arrest of conduction. 1, normal record; 2, retardation after twenty minutes' application; 3, arrest after forty minutes; 4, record of direct stimulation.

a fourth record was taken under direct stimulation, which proves that the motile excitability of the leaf had remained unimpaired.

It is interesting to note that the abolition of conducting power takes place quicker under the action of poisons which are more virulent. Thus under the action of potassium cyanide solution the conducting power was abolished in a period of application as short as five minutes.

(2) *The Conductivity Balance.*

For demonstrating the universality of nervous conduction in plants I have experimented on isolated conducting tissue of ordinary plants,

the method of investigation being electrical. And for this purpose I have devised a new method of extreme delicacy, known as the Method of Conductivity Balance. An isolated conducting strand of the plant is taken and stimulus applied about the middle. Excitatory waves travel along both arms of the balance through the conducting regions to the right, and also to the left, and induce excitatory electro-motive effects at two responsive points. The excitatory electrical effects at these points are opposed, and when they are equal they balance one another, the resulting galvanometric indication being reduced to zero. Exact balance is produced by bringing the stimulator nearer one of the two responsive points. In order to study the influence of an agent on conductivity, we first take a balanced record, and then apply the given reagent on a short length of the conducting arm, say, to the right.

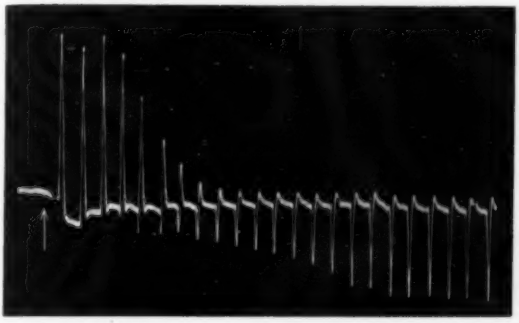

FIG. 19.

Record of effect of dilute solution of Na_2CO_3 on variation of conductivity. Record commenced with exact balance; reagent applied on right arm at moment marked by arrow. Note immediate enhancement of conductivity giving rise to up-curves, followed by depression exhibited by down-curves.

If the effect of the agent be to induce an enhanced conducting power the excitation transmitted to the right will be greater, there will be *overbalance* to the right, and the response caused by the upsetting of the balance will be upward. But if the agent had caused a depression of conduction there would be an *underbalance*, and the resulting response would be downwards. In this way we can study the accelerating and retarding effects of various drugs on conduction of excitation (fig. 19). Again, we can compare the relative effects in conductivity-variation brought about by different agents, which are applied simultaneously, the record giving us a continuous graphic

illustration of the relative and varying effects of the two, one on the arm R, the other on L.

We may similarly compare the conductivity and excitability changes induced by the same reagent.

(IX) Effect of Drugs on the Pulsation of Rhythmic Tissue.

In studying the effect of chemical agents in the form of gases and liquids, automatic records of pulsation are first taken under normal conditions, and the gases and vapours subsequently introduced into the plant chamber, or the liquid agent applied internally or externally. Internal application may be secured by forcing in the solution at the cut end of the petiole by means of hydrostatic pressure.

As regards the action of ether, the effect of very diluted vapour is generally to induce a transient exaltation, followed by depression and arrest of pulsation. If the leaflet be subjected to strong vapour and if

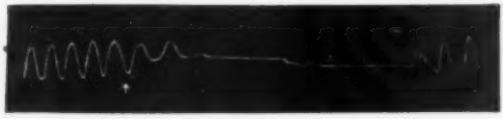

Fig. 20.

Arrest of pulsation of *Desmodium* under ether; restoration of pulsation on blowing off ether. The arrow indicates the time of application.

the application be prolonged the arrest is apt to be permanent. But if diluted vapour be employed and fresh air substituted immediately after the arrest, then there is a slow revival of pulsation (fig. 20). The effect of chloroform is similar to that of ether, its reaction, however, being far more toxic; a slight excess in the application is attended by a permanent arrest of pulsation.

This and numerous other reactions exhibit the remarkable similarity in the effect of various chemical agents on the animal and vegetable tissues. A very striking characteristic is the antagonistic reaction of acid and alkali on the animal heart. Application of very dilute acid induces in the heart an atonic reaction, in consequence of which there is brought about an arrest of pulsation in the relaxed or diastolic condition. The action of dilute alkaline solution is the very reverse of this—namely, a tonic contraction and arrest in systole (figs. 21 and 23). I find these effects repeated in an astonishing manner in the pulsation of

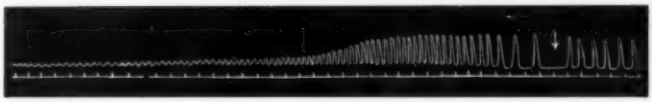

FIG. 21.

Arrest of pulsation of the heart of frog in diastole by the action of dilute lactic acid (Gaskell). Record to be read from right to left in this and following figures.

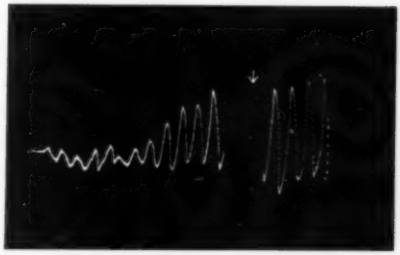

FIG. 22.

Arrest of pulsation in *Desmodium* in diastole by the action of dilute lactic acid.

FIG. 23.

Arrest of pulsation of heart in systole by the action of dilute NaHO (Gaskell).

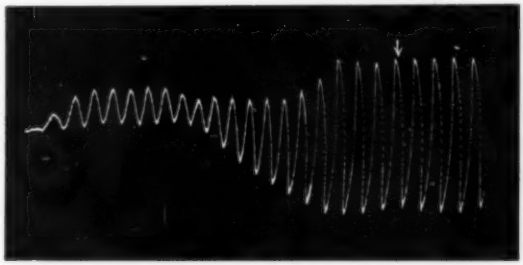

FIG. 24.

Arrest of pulsation of *Desmodium* in systole by the action of dilute NaHO.

Desmodium. The internal application of dilute solution of lactic acid is seen to induce an arrest in a state of diastolic relaxation (fig. 22). The application of dilute NaHO solution, on the other hand, induces exactly the opposite effect—i.e., an arrest at systole (fig. 24).

(X) Modifying Influence of Dose.

Another striking result that came out in my investigations on plant reactions is the modification of effect brought on by the strength of the dose. Thus, a poisonous reagent which caused depression or death was found to act as a stimulant when administered in minute quantities.

As regards application of electrical current in medical practice, it is assumed that Pflüger's law, that it is the kathode that excites and anode that causes depression, is universally applicable. I find, however, that here, too, the strength of the current is a very important determining factor. Though the application of the anode causes depression with moderate currents, the reaction is completely reversed when the intensity of current exceeds a certain limiting value.

The very great importance of the influence of intensity on the character of reaction was exhibited in a still more striking manner in my investigation on enhancement or depression of nervous conduction. The application of positive polar force induced, as we have seen, an enhancement, and the negative force a depression, in the conducting power, culminating in its complete arrest. But the result was subject to great modification dependent upon the intensity of the force. When the positive force was gradually increased, the conducting power was also increased till it reached a critical point; beyond this there was produced a complete reversal. The force which had hitherto caused an enhancement now caused a profound depression when carried beyond the critical point and finally brought about arrest of conducting power. The application of a negative force also led to a similar cycle of change. The increasing intensity caused enhanced depression; beyond a critical point the effect was reversed into increased conductivity above the normal. It will thus be seen that want of knowledge of the critical factor may bring about a result exactly the opposite of what was intended.

(XI) The Molecular Cycle.

We have seen how two precisely opposite results may be brought about by an identical drug or by an electrical current, owing to the

varied strength of application. There is, however, still another obscure factor which creates great perplexity. A given agent may cause a certain effect on one individual and an altogether different effect on another—"what is one man's meat is another man's poison." This difference is considered in some mysterious manner to be due to the varied constitutions of the individuals. As a concrete example I may cite the different reactions given by three batches of seedlings primarily similar. These were kept for some time under three distinct conditions and afterwards subjected to the action of a given dose of dilute poison. The first batch succumbed to the poison immediately; the second struggled for a time against it, recovered and exhibited a moderate rate of growth afterwards. But the third batch was actually stimulated by the poison and demonstrated this by invigorated growth!

Why should we find this difference? We must remember that the living tissue is not merely a mass of inert matter, but is a complexus of matter and energy held latent. The tissue may thus exist under widely different conditions, according as to whether it has been rendered active by the stimulating influence of its environment or reduced to a state of lethargy through being deprived of this. The source of stimulus here referred to includes every cause, internal or external, which brings about excitation. From the normal state of vigour the condition of the tissue may, according to circumstances, be carried to two opposite extremes—the state of inanition through lack of stimulation, and the state of exhaustion through excess of stimulation. Between these two extremes are numerous gradations of tonic condition in the living tissue, these being determined by its past history; and it is impossible to predict what the answering reaction of the organism will be unless we know the exact position of the tissue in the scale of tonicity.

How, then, are we to obtain some measure of this obscure internal condition? There are two conceivable ways in which this could be attempted. One, by the study of outward posture or appearance of the organism; and second, by the character of its answers to testing shocks.

A trained observer may be able to draw his inferences more or less accurately from outward appearances, but with plants we can depend on something more definite than this rule-of-thumb procedure. In the most favourable tonic condition of *Mimosa*, for example, the leaf is held out at a certain angle determined by the tonic contraction of the tissue. When the plant is kept completely isolated from all sources of stimulation

it grows atonic, the tissue becomes relaxed, this being outwardly exhibited by the abnormally erect posture of the leaf. The plant is brought once more to a normal condition when subjected to the action of stimulus, the leaf once more occupying its normal outspread position. Under further stimulation the contractile movement reaches a limit, and when stimulation is carried to excess, the contractile movement of fall is reversed into erectile movement of relaxation. If we had attached a recording lever we should have found a complete curve traced, something like this:—

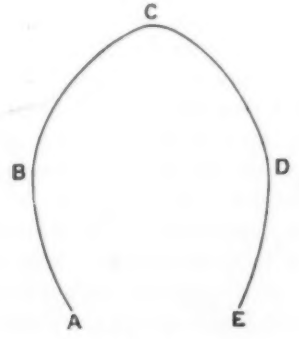

FIG. 25.

Characteristic cyclic curve showing growing contraction brought about by increasing stimulus from atonic **A** to **C** through subtonic **B**; subsequent reversal under over-stimulus; **D** moderate, **E** excessive fatigue.

In the study of this curve it should be remembered that, on account of the method of record employed, the up-movement of the leaf is shown by the descent of the curve and vice versa. These outward manifestations are the expressions of internal molecular change of a physico-chemical character, and the cyclic curve representing the varied conditions of the tissue I shall refer to as the *Cyclic Molecular Curve.*

It will be seen from the diagram that a point in the ascending has a corresponding point in the descending curve. From this we can see how liable we are to draw a wrong inference from exclusive reliance on outward appearance or posture; for example, the parallel relaxed positions of **A** and **E** may have been brought on by two diametrically opposite conditions—i.e., extreme atonicity as at **A**, over-fatigue as at **E**. In order to restore the tissue to the normal, the aim should be to bring it to the optimum condition **C**. For

this, diametrically opposed treatments are necessary, depending on the question of whether the tissue is at **A** or **E** condition. If it be at **A** stimulation is necessary, if at **E** rest or sedative treatment. But if we mistook **E** for **A** and applied further stimulation, the case would have ended fatally through extreme exhaustion, while the other mistake would have been equally unfortunate for the plant, which would have met an untimely end through excessive inanition.

Turning next to the second method by which the changing condition of the tissue may be found from the progressive modification of replies to a testing stimulus, it is extremely interesting to find that corresponding to the molecular cycle which has been referred to, there is a concomitant cyclic variation of response. In fig. 26 I have given

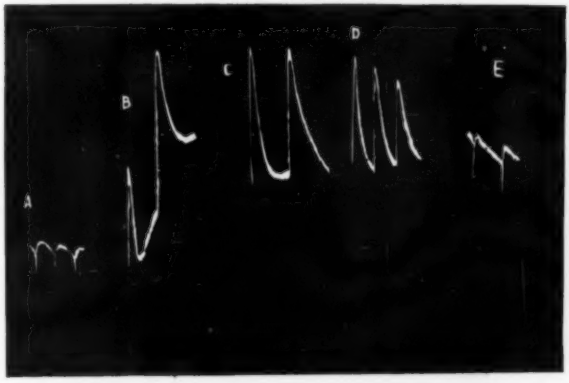

FIG. 26.

Typical responses under different molecular conditions, **A**, **B**, **C**, **D**, and **E**.

the characteristic responses of the tissue under varying molecular conditions typical of **A**, **B**, **C**, **D**, and **E**. I may say here that these results have been verified by experimenting on various kinds of tissues, the methods of investigation employed being so different as the electrical and the mechanical.

In describing the changes of response corresponding to changes in the molecular condition of the tissue, I shall for the sake of simplicity designate all normal response by contraction or by galvanometric negativity as the *negative* response; its converse—i.e., response by relaxation or galvanometric positivity—will be termed *positive* response. Beginning with the case of extreme sub-tonicity corresponding to the

point **A** in the cyclic curve, we find a maximum variation from the normal, the response being abnormally *positive*. Continued stimulation improves the general tone from a condition of relaxation to a growing tonic condition and converts abnormal positive to normal negative.

FIG. 27.

Record showing effect of stimulus modifying tonicity. Growing relaxation or atonicity arrested by stimulus at thick dot. After-effect of this induced moderate contraction. Subsequent stimuli gave rise to staircase increase in response.

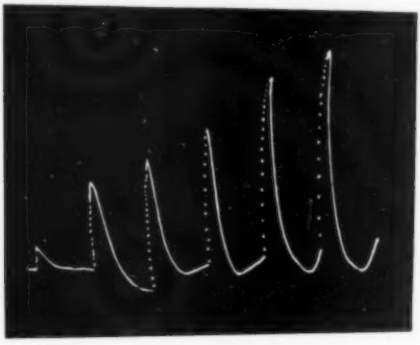

FIG. 28.

Staircase increase of response in **B** stage.

In fig. 27 stimulus applied at the thick dot is seen to arrest growing relaxation in an atonic specimen of *Mimosa*. After this, successive stimuli give rise to staircase response. At the phase corresponding to **B**, the condition of sub-tonicity is moderate; stimulus removes the

inertness and confers on it an increasingly better tone. Hence the characteristic response at this stage is a staircase enhancement (fig. 28) culminating in the optimum condition **C** (fig. 29). The highest point of the molecular cycle is thus reached. Further stimulation, strong and long continued, completes the other half of

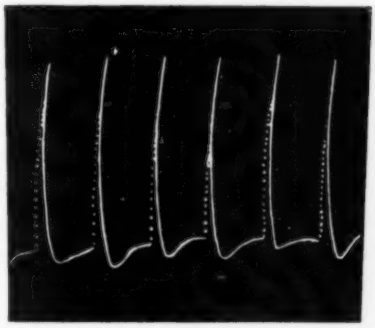

FIG. 29.

Uniform response in **C** condition.

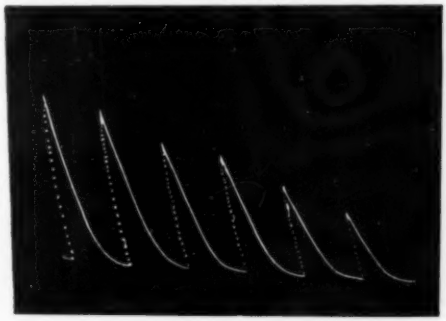

FIG. 30.

Exhibition of fatigue in the **D** stage.

the cycle, now of descent. During this descent the response at first undergoes a change from negative to less negative; that is to say, there is an appearance of fatigue (fig. 30). Again, under excessive stimulation the response may decline to zero, or even undergo a reversal to abnormal *positive*. As in the characteristic curve so also

in the series of responses, the two halves of the cycle are strangely alike, one being as it were the reflection of the other. The cycle begins with extreme sub-tonicity due to lack of stimulation and ends with exhaustion brought on by excessive stimulation. The starting point of the one may be supposed to meet the end of the other in a common fatality. But though the one half thus mimics the other there is, as it were, a polar difference between the two, by reason of the difference in their past histories, necessitating treatment which must be diametrically opposite according as the tissue happens to occupy the beginning or end of the cycle.

Thus it is clear that the progress of medicine may be greatly facilitated when the attention of investigators is drawn to the importance of the molecular aspects of the phenomena with which they have to deal. Thus in examining the action of drugs a threefold question is seen to rise. It must first be determined what is the nature of the reaction induced by the given agent under normal conditions. The second matter of inquiry is what is the critical dose above and below which opposite effects are brought about? And finally, as the nature of the response is profoundly influenced by the position which the tissue then occupies in the curve of molecular cycle, it follows that the most important element in the application of a curative agent will be in the determination of the place of the tissue in the cyclic curve.

I have given, this evening, accounts of various experiments which seem to bring the plant much nearer to us than we ever thought. We find that it is not a mere mass of vegetative growth, but that its every fibre is instinct with sensibility. We find it answering to outside stimuli, the responsive twitches increasing with the strength of the blow that impinges on it. We are able to record the throbbings of its pulsating life, and find these wax and wane according to the life-conditions of the plant, and cease with the death of the organism. We have seen how the whole plant is made one by conducting threads, so that the tremor of excitation initiated in one place courses through the whole; and how this nervous impulse, as in man, can be accelerated or arrested under the several actions of drugs and poisons. In these and many other ways the life-reactions in plant and man are alike: and thus, through the experience of the plant, it may be possible to alleviate the sufferings of man.

Sir HENRY MORRIS expressed his great appreciation of Professor Bose's lecture and invited discussion, but before the discussion began he wished to call the attention of the Fellows present to the fact that they had with them a number of their Belgian confrères. He felt sure that it would be the wish of the Society to give these gentlemen a very hearty welcome, and to express to them the high appreciation the profession, in common with all His Majesty's subjects, felt for their heroic nation, and the deep sympathy they all felt for the terrible sufferings they had borne at the hands of their barbaric invaders.

Dr. PHILIPPE: Monsieur le Président, Mesdames et Messieurs,—C'est de cœur étreint d'une profonde émotion, qu'au nom des médecins belges réfugiés à Londres je prends la parole pour remercier de tous les élans de notre cœur reconnaissant l'illustre Société Royale de Médecine. La grande faveur que la célèbre compagnie accorde à nos confrères, en nous reçevant avec l'insigne honneur de cette séance, restera gravée dans nos cœurs, et nous prions encore Monsieur le Président, Mesdames et Messieurs, d'agréer ici le témoignage de notre infinie gratitude. Quelle consolation pour nous, au moment où la plus affreuse détresse étreint notre malheureuse patrie, de trouver au sein de votre Société comme un coin de notre foyer familial où les cœurs anglais battent à l'unisson des notres. L'admirable élan de générosité de votre noble pays a trouvé toutes les délicatesses; car après avoir offert à nos compatriotes l'hospitalité la plus touchante, voici que vous apportez à mes confrères, plus éprouvés peut-être par l'absence de toute action intellectuelle que par les privations matérielles, le pain de la pensée, qu'ils iront cueillir dans vos bibliothèques merveilleuses et les laboratoires que votre confraternité idéale met à notre disposition. Monsieur le Président, Mesdames et Messieurs, jamais la Belgique n'oubliera les chaleureux sentiments d'altruisme que la Grande-Bretagne lui a montrés en ces abominables et tragiques journées. Quand notre pauvre patrie broyée se redressera, croyez-le bien, chers amis et alliés, la Belgique lavée des infames souillures de l'étreinte germanique, saura reconnaître solennellement, dans un élan d'infinie gratitude, la réception inoubliable que votre admirable pays a réservé à ses enfants, écrasés peut-être aujourd'hui, mais toujours invaincus.

Sir LAUDER BRUNTON: Mr. Chairman, Ladies and Gentlemen,—I am sure we have all listened with very great interest and profit to Professor Bose's admirable exposition of his wonderful experiments. Personally, I think perhaps my pleasure is all the greater because just fifty years ago I made some experiments upon the movements of plants myself, but the crudeness of those experiments compared with the refinement and accuracy of Professor Bose's makes one feel that within the last fifty years the physiology both of plants and animals has become practically a new science. My attention was attracted to the effect of drugs upon plants when I learned in 1863 that the late Sir James

Simpson had found that chloroform given quickly to a sensitive plant would cause the leaflets to shut up and the leaf to fall in consequence of the irritation, just as chloroform given in the same way to a person would probably cause irritation and struggling. But if chloroform were given very gently to a sensitive plant it seemed to produce no irritation at all. The plant remained apparently absolutely unaffected, but on giving it a gentle stroke it was no longer sensible to the stimulus, just as a patient chloroformed in the same way would go quietly over without struggling, but would become insensitive to pain. For a number of years, practically no important advance was made in our knowledge of the movements of plants, until 1874, when Sir John Burdon Sanderson[1] observed that the sudden closure of the leaf in Venus's fly-trap was accompanied by electrical changes similar to those that occurred in muscle. In 1882 he gave a fuller description of his work in a lecture to the Royal Institution, republished in his memoir. He there showed the existence of a latent period, of transmission of stimuli in the plant, and of a special irritability in some cells. The transmission of stimuli had been previously explained by the passage of fluid from one part of the leaf to another, and in 1882 Douglas Cunningham[2] showed that the cells in Mimosa were very porous, so that such passage was very easy. Almost simultaneously, however, Walter Gardiner[3] showed that there was continuity of protoplasm between the cells, a kind of protoplasmic network which might act as a conductor of stimuli. Sanderson says in his lecture, "Everyone who looks at a sensitive plant or the fly-trap is led to exclaim 'If it had nerves we could understand it.'" This was my own view fifty years ago, and I find that in an essay "On the Movements of Plants," which I wrote in 1865, a year after I had begun to experiment upon them, I said, "When I began to write this essay I had the inclination to the belief that plants as well as animals have a nervous system, but I now think that if they do possess something analogous to it, it is very different in kind." I think that although Professor Bose has spoken of the transmission of stimuli in Mimosa as nervous, he uses the term colloquially to explain his meaning, just as he has sometimes used the term muscular in this lecture when speaking of the pulvinus. For he himself has measured the time required for the transmission of stimuli and has shown that in Mimosa it is about 20 or 30 mm. per second, whereas in the nerves of animals it is about 27 metres per second—i.e., a thousand times as quick in nerves as in the plant—so that although there is great similarity in the effects, the time required is very different, and in the plant the conduction-time is more nearly allied to that of partially differentiated protoplasm, like the bundle of His and Stanley Kent in the heart, than to that in ordinary nerves.

Professor Bose's experiments on the curious resemblance between the movements of *Desmodium gyrans* and the heart are entirely new and very

[1] "Sir John Burdon Sanderson: a Memoir," Oxford, 1911, pp. 190, 191, 195.

[2] Douglas Cunningham, *Proc. Roy. Soc.*, 1882, xxxiv, p. 268.

[3] Walter Gardiner, *Proc. Roy. Soc.*, 1882, xxxiv, pp. 174, 272.

striking indeed; but more remarkable still, I think, is his extraordinary widening of our conception of life and of sensitiveness, not only extending it to plants which have no power of movement, such as cabbage or carrot, but even in some of his other writings to inanimate things. He seems really to show the correctness of some of the very old views of the universe to which we have attached, of late years, but little importance. In Kingsley's "Hypatia," the hero talks of the earth as being sensitive and feeling when the ploughshare is dragged over its surface; but a still wider conception is that of St. Paul, who extends the idea of sensation to the whole universe when he says, "For we know that the whole creation groaneth and travaileth together in pain until now."

Professor Bose himself would trace the idea much farther back in the world's history than the time of St. Paul, for in a lecture on stimuli which he gave at the Royal Institution in 1901 he said, "It was when I came upon the mute witness of these self-made records and perceived in them one phase of a pervading unity that bears within it all things—the mote that quivers in ripples of light, the teeming life upon our earth, and the radiant suns that shine above us—it was then that I understood, for the first time, a little of that message proclaimed by my ancestors on the banks of the Ganges thirty centuries ago. They who see but one in all the changing manifestations of this universe, unto them belongs Eternal Truth—unto none else, unto none else."

I think that both from what he has shown and what he has suggested Professor Bose's experiments are most remarkable and open up a field of knowledge and conjecture such as almost amounts to an introduction into a new world.

I have very great pleasure indeed in moving a hearty vote of thanks to him for his admirable lecture.

Dr. LEES: I have much pleasure in seconding the vote of thanks which has been so eloquently moved by Sir Lauder Brunton. We are grateful to Professor Bose for the instructive and suggestive lecture to which we have listened, and for the demonstration by which it has been illustrated. He has given us much food for thought. He has shown us that the fundamental processes of life revealed to us in the animal by the science of physiology can also be detected in the plant, that Death is as definite an event in the vegetable as in the animal, and that in both there is a mysterious connexion between Life and electricity. Thus we are brought to the conception of the essential unity of Life in all its very varied developments, in the simplest vegetable organism and in the most highly organised animal. And when we remember the modern electrical theory of the Matter on which Life is continually operating, we begin to understand the importance of the electrical accompaniments of Life. Professor Bose has proved to us that the plant, like the animal, has its nocturnal sleep; that it can exhibit evidence of fatigue, which can be removed by a temporary rest; and that it is susceptible to the influence of

drugs. Of special interest is his demonstration of the opposing action of acid and of sodium bicarbonate on the vegetable tissues, which he has shown to be analogous to the opposing action of these drugs on the heart of the frog, as demonstrated by Dr. Gaskell many years ago, and illustrated by their action in disease in the human subject. In every case of acute and subacute rheumatism the left ventricle is dilated by the action of the acid toxin generated by the rheumatic diplococcus, and the influence of large doses of sodium bicarbonate in diminishing this dilatation and increasing the tone of the ventricular wall is an important fact in therapeutics. It is even more remarkable that in at least one plant a rhythmic pulsation of leaflets, analogous to the automatic pulsation of the animal heart, can be observed, and that Professor Bose finds this rhythmic pulsation in the plant susceptible to external influences just as is the automatic pulsation of the heart of a frog. Does not this throw a new light on that fundamental fact of animal physiology, the cardiac pulsation, which is one of the earliest developments of fœtal life, beginning before the muscular or nervous structures of the heart have been differentiated? We desire to express our thanks to Professor Bose for the trouble he has taken in coming so far in order to give us this demonstration of the results of his scientific investigation.

The Royal Society of Medicine.

March 30, 1915.

Dr. Frederick Taylor, President, in the Chair.

An Address on Wound Infections; and on some New Methods for the Study of the various Factors which come into consideration in their Treatment.

By Colonel Sir A. E. Wright, M.D., F.R.S.[1]

There are a number of quite elementary problems which must be solved before we can arrive at any really effective treatment of wound infections. A very brief consideration of the facts will bring us face to face with the questions to which we have to find an answer.

Evolution of Wound Infections.

In this war practically every wound is heavily infected. The chain of cause and consequence seems to be as follows: The clothes and skin of the soldier on war service become contaminated with all manner of filth containing pathogenic organisms and spores; the projectile takes these in with it, and it implants them far beyond the reach of any prophylactic applications of antiseptics.

A cultivation medium is now provided by the blood and lymph which are poured out into the track of the projectile; and we find in the wounds—I have in view here wounds examined immediately after arrival from the front—a mixed infection of a streptococcus with microbes derived from the fæces. This fæcal infection is a special outstanding feature in this war.

Among many species of intestinal microbes which have been found in wounds, two have a quite special importance. One is the *gas-phlegmon bacillus*, or *Bacillus aerogenes capsulatus* of Welch—a large Gram-staining, anaerobic and actively gas-forming microbe. It is found

[1] A Consulting Physician to the Expeditionary Force. (From the Research Laboratory attached to No. 13 General Hospital, Boulogne-sur-Mer.)

both in infiltrated superficial wounds and in deep wounds, and is particularly abundant in the frothy and offensive fæcal-looking discharges which anaerobic wounds furnish. The other is the tetanus bacillus. This is more rarely encountered, and is also much less abundant in the discharges. Sometimes, however, it may show up in every field of the microscope.

The presence of the streptococcus and these two fæcal microbes makes the first period of the wound infection—the period of imprisoned discharges—a specially critical time for the patient. During this the streptococcus may invade the tissues, and set up cellulitis or, more rarely, erysipelas. Or the tetanus bacillus may find opportunity to grow out and manufacture its poison and induce tetanus. Or the bacillus of Welch may make its way into the body and set up a gas-phlegmon in the region round about the wound, and an obstructive gangrene in the distal portion of the limb. Or, again, the bacillus of Welch and the streptococcus may join forces, and may in conjunction produce the gas-phlegmon or cellulitis.

As soon as a free outlet has been provided, and aerobic conditions have been established in the wound, its bacterial flora changes. The ordinary pyogenic infection, which has up to this been in abeyance, now gains the upper hand, and instead of an "*infection of the imprisoned discharges*," or, as the case may be, *an infection of tissues*, we have now an "*infection of the granulating wound surfaces, and of the flowing discharges.*" The chief bacterial agents here at work are the streptococcus and staphylococcus, and *Bacillus proteus.*

This pyogenic infection may, after lapse of time, subside—the wound healing up when this occurs; or the mixed infection may narrow itself down to a streptococcic infection and become chronic, the wound in this case remaining open indefinitely in the form of a discharging sinus. Or, lastly, when there is an obstructed outflow, the infection may go from bad to worse until the patient succumbs to continued suppuration and septicæmia.

Some Fundamental Considerations in regard to Treatment.

Those are, in very brief summary, the facts with regard to the evolution of wound infections, and I would venture, in passing on to discuss with you their treatment, to remind you that the ideal we ought to approximate to is the healing of the wounds by *first intention*—that is, without sensible interference by bacterial infection; and that so far

are we from the attainment of that ideal that nearly all our wounded are suffering from bacterial infections; that very many are ill of these infections; and that not a few are, through these, in danger of their lives.

We have at our disposal for the treatment of these wound infections three distinct therapeutic measures. Let me enumerate them in the order in which they would naturally suggest themselves to you.

First in that serial order would come *treatment by antiseptics.* After this would come what I propose to call *treatment by physiological methods*—I mean procedures such as the opening and draining of the wound—which bring the antibacterial powers of the blood to bear on the infecting microbes. And lastly would come the reinforcement of the antibacterial powers of the blood, that is, *treatment by vaccine therapy* and similar methods. I believe it is really above all question that of these three the second is beyond all comparison the most important, and I would submit that—all loud talk about antiseptic treatment notwithstanding—this is at best an ancillary method of treatment. And of course the same applies also to treatment by vaccines.

Let me also here suggest to you another quite fundamental consideration. It is this: It will be clear that we cannot apply physiological treatment aright, nor can we use any antiseptic or vaccine to best advantage in wound infections, unless we first understand the physiological processes going on in the wound. We do not understand these yet even in outline.

It will therefore be necessary to address ourselves to the task of discovering what goes on in the wound and of following up its biological evolution. And the only way of doing this will be to formulate to ourselves in clear terms the questions which want answers; then to consider how to set to work to get our answers—for merely looking at the wound will not help; and finally to take cognisance of the results which the experimental methods I am about to describe to you have already yielded.

Our first question can be formulated thus:—

(1) *Can the microbes which are found in wound infections live and multiply in the unaltered blood fluids?*

In other words, if I take pyogenic microbes from the wound and implant these into the normal undiluted serum, will they multiply in the serum and give me a satisfactory culture? If we are going to carry out this experiment, and to carry it out repeatedly, and deal with a number

of different bloods; and if we are going to cultivate directly from the pus, we shall evidently have to work in capillary tubes with very minute quantities of pus and very small quantities of undiluted serum. The technique which I have arrived at for fulfilling these requirements is a very simple one. I may call that technique the *wet-wall method.*

Method of making Cultivations of Pus in Serum, by the Wet-wall Method.

The first step in the procedure is to make, by the technique I described in my book on "Technique,"[1] a graduated series of dilutions of pus, using for this purpose any indifferent diluting fluid, and arranging the successive dilutions on a slide in the form of a series of drops (fig. 1, slide 1). I then take in hand a clean capillary pipette fitted with a teat, make a mark upon the stem, and then draw up into it a series of unit volumes of serum, one unit volume of serum for every dilution of the pus. This done, I commence with the highest of these dilutions—that is, the one containing the smallest number of microbes—and draw it up into the stem of the pipette, stopping off exactly at the fiducial mark (fig. 2). I then expel this column, leaving, of course, as I do so, the walls wet with a quantum of microbial suspension—a quantum which would correspond roughly to that which would be left on the outside of a platinum wire of similar stoutness dipped into the suspension. I now expel from my capillary tube my first volume of serum—this in passing over the wet wall will take up its charge of microbes—and I receive this as it issues on to a clean slide. I repeat these manipulations with the next lower dilution of pus and the next unit volume of serum, and so on, until I have implanted my series of volumes of serum with my series of bacterial dilutions. At the end I find myself with a series of drops of serum containing graduated charges of microbes, ranged in order upon a slide (fig. 1, slide 2); and I have in my hand a pipette which is contaminated up to the point indicated by my fiducial mark. I get rid of this contaminated segment of my capillary stem by resecting this just above the fiducial mark, and I now proceed to draw up into my pipette, separating off by bubbles of air, the whole series of drops of serum, beginning with that implanted with the fewest microbes. After sealing up the distal end of the pipette, and closing the butt end by bringing it down upon a bed of plasticine, the pipette is placed in the incubator. After an interval of six to twenty-four hours it is taken out, and the series of unit volumes are now, for

[1] "Technique of the Teat and the Capillary Glass Tube," Constable, London.

purposes of microscopic examination or culture, expelled from the pipette in the order in which they have been taken up—that is, in succession from the lightest to the heaviest implanted. This is effected by cutting through the proximal end of the stem of the pipette and then the distal end, and afterwards luting the latter air-tight into the truncated end of the pipette. The luting is done by rolling a little plasticine into a ball, pressing the capillary stem into this pellet as we hold it between finger and thumb, doubling over the plasticine round the stem; and then invaginating the capillary stem, thus cushioned, into

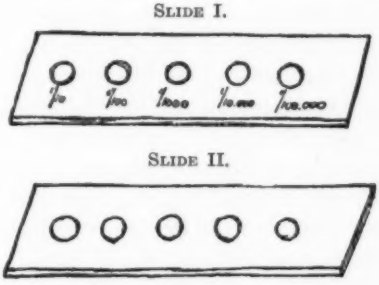

Fig. 1.

Slide I: Graduated dilutions of pus arranged on slide. Slide II: Volumes of serum implanted with the above dilutions of pus.

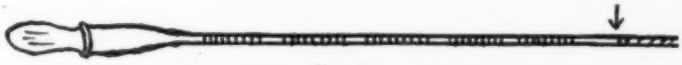

Fig. 2.

Capillary pipette filled with five unit volumes of serum and one unit volume of the last dilution of pus.

the neck of the pipette. We can now with a teat expel our series of unit volumes of serum on to a slide, obtaining them in the serial order which avoids the contamination of the lighter implanted with the heavier implanted.

Method of making Anaerobic Cultures in Capillary Tubes.

When we desire to make anaerobic serum cultures we do not employ the capillary pipette used for the original implanting operations as a receptacle for our series of serum cultures, but employ instead a separate capillary cultivation tube for each unit volume of serum. The capillary cultivation tubes here in question are made as follows: We take a portion of capillary stem, say some 8 cm. long, draw it out at one end

in the flame of a by-pass into a hair-fine tube, and then break it off, leaving a certain length of throttle attached. We now introduce the other end of the capillary stem into the flame of our Bunsen, and let gravity bend it round into a siphoning curve.

Taking one of these capillary cultivation tubes we bring down the siphon end upon our drop of serum (fig. 3, *a*), and let this run in, afterwards tilting the tube so as to take in, as a rear-guard, a good-sized dividing bubble of air. This done, we fill into our tube, by siphonage, from watch-glasses placed conveniently to hand, first a small quantity of pyrogallic acid, and then, without dividing off, a small quantity of caustic soda (fig. 3, *b* and *c*). We now further incline the tube, and let the contained fluids gravitate down towards the distal end until the serum begins to enter the throttle. At that point we arrest it by sealing the tip, and we finally also seal up the butt end, leave the mixed pyrogallic acid and caustic soda to do their work and absorb all the oxygen from the dividing bubble air (fig. 3, *d*).

Serum cultures made by this method furnish a very striking and uniform result. We obtain in the cultures implanted with the higher dilutions of the pus a pure culture of the streptococcus, and in the cultures more heavily implanted with the pus the streptococcus mixed with a certain number of other microbes: in particular, a few staphylococci and an anaerobic wisp-like diphtheroid bacillus which often is abundant in pus, being found both intracellularly and extracellularly. All the other pyogenic microbes appear to be inhibited in undiluted normal serum, and when they put in an appearance it is only after fairly heavy sowings with pus, and comparatively late.

Out of these facts would come what we shall presently see to be a practically important classification of pyogenic microbes—a classification into, on the one hand, *serophytes;* and, on the other, *serosaprophytes.* The serophytes would be those which, presumably because they find their foodstuffs ready made in the blood fluids, are at home there, and can, in the absence of phagocytes, grow and multiply there without restraint, or practically without restraint.[1] The serosaprophytes would be those which cannot grow and multiply in the blood fluids until a change—which we may, pending nearer investigation, call simply a *degenerative* change—has passed over those fluids.

What holds true of the blood fluids themselves might perhaps

[1] I introduce this qualifying clause because I have on several occasions found the serum of the infected patient to give cultures of streptococcus with a planting of his pus much smaller than that which was required to give a culture in the serum of a normal man.

justifiably be assumed to hold true also of the lymph which pours into the wound. None the less, it will be well specially to investigate this point.

(2) *Does the lymph which pours into the wound provide a favourable nutrient medium for the microbes which have been growing in that wound?*

To pose this question is already to go a long way towards getting an answer to it; for we can, by the aid of a very simple device, obtain the lymph from the walls of the wound. I employ for this purpose

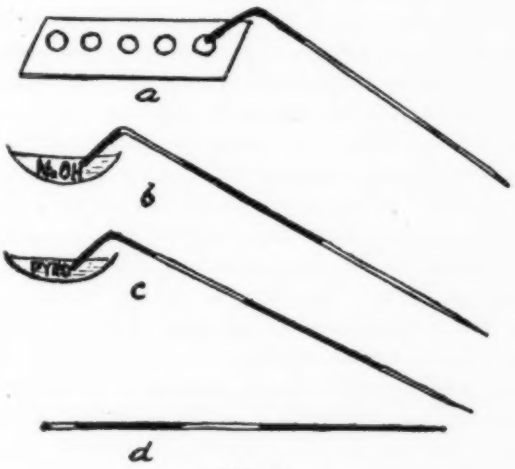

FIG. 3.

Method for making anaerobic cultures in capillary tubes.

what I may perhaps call a *lymph leech*. This consists, as you see, of a small glass tube. It is sealed up at one end, drawn out at the other in the form of a nozzle, and is furnished with a lateral mouth with a raised rim—the whole being very easily made out of a piece of glass tubing, or small test-tube. To the nozzle we fit a piece of fairly thick walled rubber tubing, and this is blocked at the end with a piece of glass rod. When we want to obtain the exudate from a wound we bring down the lateral opening of the lymph leech upon a granulating surface, and then, transfixing the rubber tube with the needle of a hypodermic syringe, we draw out the air and make a negative pressure (fig. 4). It will be appreciated that the lymph leech is in principle

merely a small cupping glass, and that it will, by means of the vacuum we establish in it, hold on tight for whatever period may intervene between dressing and dressing, and furnish an exudate free from all contamination with residual pus left behind in the wound. We can now proceed to compare the fluid in the cavity of the leech with the fluid in the wound outside; or, in connexion with work on antiseptics, to compare the contents of leeches applied respectively to treated and untreated surfaces in the same wound.

And lymph leeches also can be put to other uses. We can introduce for this purpose with a syringe any fluid we may select into the lymph leech, and investigate the effect that fluid exercises upon transudation and emigration. Again, where the nature of a deep-lying infection of a mucous or other surface remains uncertain, the application of a lymph leech might clear up the difficulty. We can also, in the case where we are testing the effect of a vaccine upon a wound, take to our aid the lymph leech. For the effect of a vaccine would probably show itself in the exudate in the cavity of the leech long before it would manifest itself in the outside wound. And, lastly, the application of a lymph leech to the site of inoculation might, perhaps, help to resolve the problem as to whether or no protective substances are then developed.

But it will be realised that for us—at the moment—what is of chief interest is the comparison of the fluid in the cavity of the leech with the fluid in the wound outside.

When, after washing out a heavily infected wound with an antiseptic or simple saline solution, we apply a lymph leech to the walls, and then at the next dressing compare the contents of the lymph leech with the fluid outside, we think at first that there must be some mistake. Outside we have an opaque exudate presenting all the ordinary physical characters of pus containing leucocytes in all stages of degeneration, and swarming with all manner of pyogenic organisms. Inside we have a transparent and slightly blood-stained exudate containing streptococci in practically pure culture, and in addition a few leucocytes, all of which are actively phagocytic. Except in this latter respect, we have, in fact, identically the same result as when we made our thin implantations of pus into normal serum.

The problem now stares us in the face—What is it that makes all this difference between the contents of the lymph leech and the contents of the wound? How has the lymph, which gives in the cavity of the lymph leech only a culture of streptococcus, been converted in the wound outside into a fluid which is ideally favourable to the growth of a great number of different species of micro-organisms?

(3) *What is the cause of that "corruption of the lymph" which converts it into a favourable nutrient medium for sero-saprophytic microbes?*

The proper way to go to work upon a problem of this kind is to keep it unremittingly before the mind; for then some hypothesis will in the end suggest itself. That found, there will invariably come to notice a certain number of accepted data which the hypothesis will fail to explain. These must then be carefully re-examined to see whether they will stand fast and discredit the hypothesis, or whether they also will come in and support it. And, finally, before launching our theory, we ought to think out all its consequences, and then take each of these and verify it.

At any other time one would wish, before promulgating a far-reaching hypothesis, to have verified it at every point. But we have

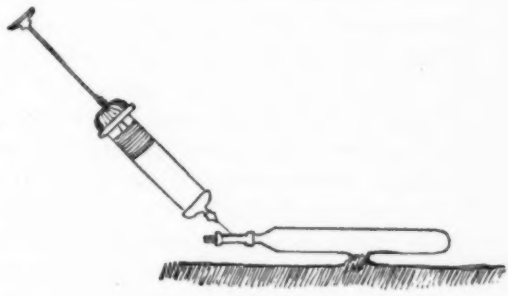

FIG. 4.

Lymph leech.

on our hands in Europe, I suppose, already two or more millions of wound infections, and every other consideration must give way to that of accelerating the researches which we must look to in order to guide us in treating these infections.

I will therefore, before completing its verification, venture to put before you what is, I believe, the solution of the problem of the corruption of the lymph in the wound.

Let me take my departure from those facts which we were considering a moment ago, relating to the culture of pyogenic microbes in the blood fluids. You will remember that I suggested in connexion with serophytic microbes that these must find all the food materials they require ready formed in the blood fluids; and in connexion with

sero-saprophytic microbes, that for these no nutrient substances would be available until the albuminous substances of the blood had undergone some sort of preparatory transformation.

I conceive that that transformation could come only by a digestive process. Now, supposing this to be so, there would come into account a counteracting influence in the serum. For we have there an anti-fermentative, or, as we usually style it, an antitryptic element, which would directly counteract any digestive element which might be struggling to come into operation. And it is clear that microbes which were dependent for their sustenance upon the products of digestive action could establish themselves in the blood fluids only on condition that this antitryptic influence was overborne.

This hypothesis furnishes, as it seems to me, an explanation of certain striking facts relating to the cultivation of microbes on blood fluids, and to bacterial infections. It, as it seems to me, explains the finding that heavy sowings of microbes into serum are effective in giving cultures, while light sowings are not only ineffective, but lethal to the implanted microbes. For it would be only natural that the resistance offered by the antitryptic power of the blood should be overborne by the mass effect of a number of microbes operating upon a restricted or —and this would come into consideration in localised infections—a mechanically isolated quantum of blood. And, again, it would be only natural that the mass effect of a large volume of antitryptic serum would effectively quench the digestive activities of a very few microbes; and also, I think, in accordance with what we know, that microbes deprived of access to foodstuffs should perish of inanition.

Our hypothesis would also make intelligible, in connexion with infections by sero-saprophytic microbes, that frequent and heavy sowings into the blood should be required before a septicæmia can supervene upon a local infection. And again our hypothesis makes it comprehensible that there should be serious difficulty in obtaining hæmo-cultures, even when the microbes have gained a footing in the blood-stream.

And, lastly, our theory brings home to us that, in considering the defence of the body against bacterial infection, we have to take into account not only *active defence* in the form of phagocytes and bacteriotropic substances which make a direct attack upon micro-organisms; but also *passive defence*—that is, protection against infection obtained by preventing microbes converting to their uses the nutrient substances of the blood fluids.

These, however, are general considerations with applications far

beyond the sphere of wound infections, and we must return to the particular problem of the corruption of the lymph in the wound.

When, after treating a wound with antiseptics and leaving it clean, we find it a very few hours afterwards teeming with microbes, we are in presence of something which, in my view, urgently stands in need of explanation; for our findings both in the lymph leech and in serum cultures made with the wet-wall method from pus would seem to teach us that the sowing of microbes left behind cannot be nearly heavy enough to produce the voluminous culture found in the wound, nor yet to account for the rapidity with which the sero-saprophytes have started to grow. And, moreover, upon consideration it will appear that another powerful factor must constantly come into operation in the wound. The factor in question is the tryptic ferment which is elaborated in the phagocytes and which is, when these break up, discharged into the surrounding medium. This tryptic ferment will come into operation under two different conditions. It will come in whenever a residue of pus—for this would contain free trypsin—is left behind in, or afterwards makes its way into, the wound. Trypsin will again come into account whenever, after the washing of the wound, leucocytes once more begin to emigrate, and phagocytose, and break down.

I see in the reduction of the antitryptic power of the lymph thus effected the prime cause of its corruption. Before attempting to obtain confirmation of this from crucial experiments, there was a set of findings to be cleared up. I had found in connexion with pus implantations made into serum that when this was heated to 60° C. for ten minutes one no longer obtained the same differential growth of streptococcus as with unheated serum; but obtained instead mixed cultures of streptococcus with sero-saprophytes, in particular staphylococcus and the wisp-like diphtheroid bacillus already made mention of. It seemed at first sight as if this could not possibly be related with a reduction in the antitryptic power of the serum; for it has, in view of the high quality of Opie's work on this question, been generally accepted from him that the antitryptic power of the serum is unaffected by exposure to heat until a temperature approaching the coagulation point of serum is reached. In reality, however, when this is re-investigated quantitatively,[1] it emerges that the

[1] The quantitative method here employed was in essentials that described in my "Technique of the Teat and the Capillary Glass Tube." It was varied only in the respect that the series of trypsin, serum, and calcified milk mixtures, which are employed in that method, were taken up, not into a many-stemmed pipette, but into a long, unmounted, wide-bored capillary stem, which had, for the purpose of convenient filling in, been bent round at one end in the flame of a Bunsen into a siphoning curve.

antitryptic power of the serum is reduced by one-third to one-half when we subject the serum to a temperature of 60° C. for ten minutes.

That difficulty having been removed out of the way of our hypothesis, we may proceed to take cognisance of the results of the crucial test experiments—experiments in which graduated additions of trypsin are made to serum as a preliminary to the implantation of sero-saprophytic microbes. The outcome of these experiments can be summed up in a sentence. When we add trypsin in quantities sufficient to reduce appreciably the antitryptic power, but insufficient to give us any free trypsin, the serum is converted into an eminently favourable nutrient medium for sero-saprophytic microbes.

Our hypothesis is thus very strikingly confirmed. It will be necessary hereafter to follow it into all its consequences. For the present it will, however, suffice if we ponder on the fact that the antitryptic power of the blood would appear to be increased in every case of severe wound infection. We have, perhaps, here a defensive reaction of the organism directed against a possible invasion of the blood by sero-saprophytes. And we may perhaps look in this direction for an explanation of the non-specific benefit which has been observed to follow upon the inoculation of bacterial vaccines. It is clearly not impossible that the inoculation of a bacterial vaccine might contribute both to active and passive defence—to the active defence of the body against a particular microbe by calling forth a production of specific bacteriotropic substances, and to the general passive defence of the organism by calling forth a production of antitrypsin. And these two forms of immunising response would not necessarily be linked together. The production of specific bacteriotropic substances would no doubt depend upon the quantum of bacterial antigen incorporated; while the production of antitrypsin might perhaps depend upon the breaking down of phagocytes and the liberation of their trypsin.

What are the Factors which Influence the Emigration of White Blood Corpuscles into the Wound?

I pass now to consider yet another subject-matter—the emigration of leucocytes into the wound. I need not labour the point that this is a factor which may determine the issue of an infection; nor need I point out that it behoves us to acquire a control over the movement of leucocytes, and then to turn this to account, as the case may be, by activating or restraining emigration.

Broad foundations for our work have, as you know, already been laid by the brilliant researches of Metchnikoff. But it was with Metchnikoff always a question of experiments *in vivo*—that is, of experiments carried out under conditions which cannot be sufficiently simplified to give quite unambiguous answers. And we require for the elucidation of our problems and for all detail work connected therewith, absolutely simple crucial experiments, such as can only be made *in vitro*.

The line of thought which I have followed in elaborating a laboratory method for the study of the phenomena of emigration is the following: The leucocytes in extravascular blood are known to retain their emigrating power. A difficulty, however, when we are working with extravascular blood, will beset our observations, inasmuch as we have not at disposal such a containing membrane as the capillary wall. We are, in fact, in dealing with extravascular blood, confronted with a situation similar to that which would be encountered in observations *in vivo* if the capillary walls were to give way and we had to make observations on emigration in a portion of tissue which was flooded out by red corpuscles.

I had hoped at first to be able to circumvent this difficulty by taking advantage of the fact that when clotting occurs the red blood corpuscles become enclosed in a meshwork of fibrin, after the manner of fish in a net. But all my efforts to make the fibrin meshwork take over the office of a containing membrane were defeated. No matter how tenderly the clot was treated the meshes of the net broke, and hæmorrhage from the clot interfered with the observations.

A second difficulty also presented itself. When in the living body white corpuscles emigrate into connective tissue it is possible to register their travel because they move forward through a retaining meshwork. It would not be possible to do so if they merely passed out into fluid, to be afterwards carried hither and thither by every chance convection current. Exactly the same applies to the extravascular blood. The emigrating leucocyte must be provided with some sort of scantling to move forward upon, and come to rest in.

After a time I alighted on a method which satisfies the two aforementioned experimental requirements, and which, as I think, provides all that is required for a quantitative estimation of emigration. Let me first tell you the general lines upon which the method proceeds, and then set out the details of the technique.

Principle of the Method employed for making Observations on Emigration.

The principle of the method is as follows: We fill in a capillary tube with blood from a prick in the finger, immediately place the capillary tube in the centrifuge, and centrifugalise until we have carried down all the corpuscles. We have now in the upper half of the tube a plasma which has been completely freed from all formed elements; and in the lower half of the tube, at the bottom, the red blood corpuscles intermixed with a certain number of polynuclear white blood corpuscles; and above this a layer made up predominantly of white blood corpuscles —these last in the front ranks consisting almost exclusively of small and large mononuclears. The blood now clots. And this gives in the upper half of the tube a clot consisting of fibrin without any formed elements—let us call this the *white clot*—and in the lower half of the tube a clot—let us call this the *red clot*—which holds all the corpuscles in its meshes. When a chemotactic stimulus now comes into application from above, the white blood corpuscles will come out from the red clot and will travel upwards through the meshes of the white clot—afterwards maintaining their positions so as to allow of our making measurements and enumerations. We will now pass to the details of the technique.

Details relating to Apparatus and Procedure.

With regard to apparatus, all that is required is a supply of flat capillary tubes. By using flattened capillary tubes we obtain a thin clot, which can more easily be examined under the microscope.

We make these tubes—and they may conveniently be called emigration or chemotactic tubes—either out of a small test-tube, or out of a length of fairly wide-bore glass tubing. We heat this in the blow-pipe flame until it becomes very plastic; then making a sharp outward turn with the right wrist, bend the tube round through a right angle, giving it the proper flattened conformation: and then draw out into a long flat capillary stem (fig. 5, A). We cut this through at the point where it begins to lose its flattened conformation: and so leave attached to the next segment a sufficient length of tube to take hold of when we go to work upon it. When a sufficient number of lengths of flattened stem have been provided, we cut these up into segments of about 8 cm. in length; arrange them side by side after the

manner of a palisade; and then with our glass writing pencil rule two lines across the face of our tubes. The first of these lines ought to fall somewhere in the middle. It is to serve as a fiducial mark for filling in the blood from the finger. The second line, which may conveniently fall at a point to about $\frac{1}{2}$ or $\frac{3}{4}$ cm. to the end of the tube, is to serve as a fiducial mark in filling in the chemical agent whose effect we are to study.

The tube may now be used just as it is; or we may before using it furnish it with a siphon curve by bending it round at the level of our second fiducial mark. We do this by taking up each tube separately, holding it horizontally, and then passing it rapidly to and fro through a small by-pass flame. The action of gravity will then, as soon as the glass softens, bend round the tube for us (fig. 5, B).

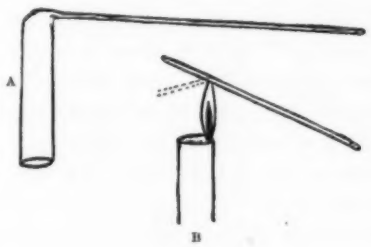

FIG. 5.

Method of making emigration tubes. A, method of giving the flattened conformation to the capillary stem; B, method of bending the tube round to form an elbow.

METHOD OF USING THE EMIGRATION TUBES, AND BRINGING THE CHEMOTACTIC AGENT INTO APPLICATION.

The emigration tube is first filled in up to the midway point with blood drawn from a puncture in the finger. In the case where we employ a bent tube this is done by letting the blood flow in through the siphon curve.

The chemotactic agent can now be brought into application in three different ways.

(1) *It may simply be superimposed upon the clotted blood.* This is done by using a *filiform pipette*, made by heating the stem of an ordinary capillary pipette in a small by-pass flame and drawing out, while with a rubber teat we apply internal pressure to prevent the walls of the hair-fine tube collapsing. Considered as a method for bringing

a chemotactic agent into immediate application, this method falls short in the respect that the chemical has to diffuse down through the whole white clot before it comes into operation. In view of this, the method does not lend itself to the institution of any comparisons between normal blood and anæmic blood. For the experimental conditions are not comparable when our chemotactic agent has, in the one case, to diffuse through a length corresponding to half the column of blood; and, in the other case, through a length which may amount to nine-tenths of that column.

(2) The *second* method of bringing the chemotactic agent into application is that of *superimposing the chemotactic agent upon the unclotted blood* (fig. 6, B and C). Having filled in a curved emigration tube up to mid-point mark with blood, we tilt the tube so as to take in a dividing bubble of air; then fill it up as far as the elbow with the chemotactic agent; and then, after sealing up the distal end of the tube, proceed to centrifuge. This method is applicable, in particular, when we are working with bacterial suspensions; for while the watery suspending fluid remains, by reason of its lighter specific gravity, on the top, the microbes are, by virtue of their higher specific gravity, carried down into the plasma to be embedded in the white clot all the way down to the leucocytic layer.

(3) The *third* method is the method of *traversing* (fig. 6, D and E). In employing this we may use either a straight or a bent emigration tube. We fill in, first, with our column of blood; follow on with the dividing bubble of air; and then, making use of the forerunning column of blood to serve as a brake, fill in up to the fiducial point with the chemotactic agent.[1] Finally, we seal up that end of the tube which has served as an inlet, and place the tube in the centrifuge.

Our chemotactic agent will now traverse the column of blood and take up a position at the top, leaving behind it in the plasma traces of whatever chemical it holds in solution. That this is what actually happens can be shown by employing, in place of a colourless chemotactic agent, a solution of methylene blue, or simple water. This last, when it follows on after a column of blood and dissolves the red blood corpuscles which this leaves in its wake, will come out at the top coloured with hæmoglobin.

The traversing procedure will be applicable in the case where we

[1] In practice the procedure of traversing is to be carried out exactly as here described. In the illustration fig. 6, D, in order to convey the idea of traversing to the eye, the chemotactic agent precedes instead of following the column of blood.

want to bring into operation chemical agents, and especially applicable where we want to bring such agents into instant application.

When we are working with a series of tubes, as will practically always be the case, it will be well to place each, as soon as it is filled, into iced water or ordinary cold water. The buckets of the centrifuge will serve as convenient receptacles. After centrifugalisation the emigration tubes are placed in the incubator, according to circumstances, for from three to twelve hours or more. While in the incubator the tubes may conveniently be placed upright—that is, with the white clot

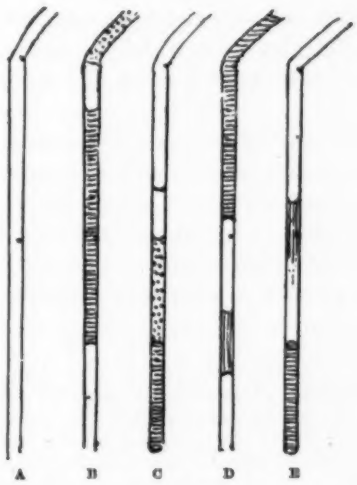

FIG. 6.

Method of adding chemotactic fluid to blood. A, curved emigration tube, empty. B, tube filled in with a column of blood, a dividing air bubble, and then, as far as the elbow, with a bacterial suspension. C, tube after centrifugalisation; the bottom of the tube is occupied by the red clot, and the intermediate portion by the white clot and implanted bacteria; at the top is the watery menstruum in which the bacteria were suspended. D, tube filled in for *traversing;* in the lower portion of the capillary stem is the chemotactic agent; in the upper part the column of blood. E, tube after centrifugalisation; the bottom of the tube is occupied by the red clot, and the intermediate portion by the white clot, containing traces of the chemotactic agent; at the top the watery menstruum containing the bulk of this agent.

uppermost—in plasticine. They may also be laid on their sides, tilted a little upwards. The inverted position is to be avoided; for when we invert our tubes we bring down into the white clot a shower of red corpuscles which block emigration and also obscure the view.

Method of bringing the Emigration Effect into View and taking Cognisance of the Results.

When all we want is to get a general idea of what is going on in the tubes, we can obtain this by introducing the unopened tube into an observation cell. A very simple form of observation cell can be made by placing small pellets of plasticine upon each of the four corners of a microscopic slide, covering in with another slide—allowing a little overlap—and then filling into the interspace either water or some more highly refractive fluid, such as glycerine or oil. By observing in such a cell we bring in view not only the leucocytes which have emigrated into the white clot, but also those which have escaped into the interspace which may develop between the clot and the walls of the capillary tube.[1]

For all purposes of quantitative observations we blow out[2] our clots into water; wash carefully so as to remove leucocytes adhering to their exterior; and then mount them on a slide. We then, after cutting off the surplusage of red clot, fix by drying, and stain for a few minutes in Kühne's methylene blue freely diluted. The specimens are examined first, dry or in water, under a low-power objective, and afterwards in oil under an immersion.

[1] Attention may, in connexion with this, be called to facts which have an importance and a useful application in medicine, which happen to have also an importance and a useful application in connexion with the emigration method here under consideration. The facts I have in view are as follows: The blood of a person suffering from chilblains, or any other manifestation of a lowered blood coagulability, will, on centrifugalisation, generally fail to give the kind of white clot we require for our emigration experiments—that is, one that is firm and non-contractile. This condition of things can be remedied by the exhibition of calcium salts, or, as the case may be, by appropriate additions of these salts made to the blood when filling our capillary tubes. I would in connexion with this emphasise that we have here brought into clear view what is really the material factor in connexion with the effect exerted by calcium salts in the blood. And I may perhaps be permitted to point out, in connexion with my own work on calcium as an agent for promoting and citric acid as an agent for diminishing coagulability (*Brit. Med. Journ.*, July 29, 1893, and July, 1894, *Lancet*, January 18, 1896, and January 30, 1897), that while what I have said with reference to the clinical effects exerted has been, I believe, universally confirmed and accepted, what I have said with respect to the effects of the coagulability of blood *in vitro* has been traversed. This stands, as I believe, in relation to the fact that the laboratory workers who have repeated my work have employed methods which took into account rapidity, but left out of account firmness, of coagulation. It will now, I hope, by adopting the method of centrifugalising, and watching the effect exerted upon plasma which has been disembarrassed of corpuscles, be possible to arrive at unanimity in these matters. Finally, I may direct attention to the fact that what comes into view in centrifuged, is seen also in uncentrifuged blood. When we make to this appropriate additions of calcium salts we obtain, as I long ago pointed out, a firmer and non-contractile clot.

[2] This is done by the same technique as described in connexion with the *wet-wall method* (*see* p. 45).

General Considerations relating to the Movements of White Blood Corpuscles.

Before passing to consider the question how it will be possible to arrive at a quantitative expression for the leucocytic movements induced by a chemotactic agent, it will be well to take a general survey of the things that present themselves to view in every emigration tube.

We have to take into account in connexion with white blood corpuscles two kinds of movements. There is, on the one hand, a process of wandering at large; and, on the other hand, a directed movement—that is, a movement along some particular axis—undertaken under the direction of a chemical stimulus. We may call the first kind of movement an *eleutherotropic* movement. The second is usually known as a *chemotactic*—I prefer to call it a *chemotropic*—movement. It is, of course, the latter, not the former, kind of movement which we are here primarily concerned to study. For clearly it is the chemotactically directed movements of the leucocytes towards the bacterial focus, and not their wanderings at large, which come into consideration in any conflict against infection.

None the less, a word may be said about *eleutherotropic movements*. One finds in every specimen of blood which has been simply centrifugalised and placed in an incubator, always a certain wandering at large of the leucocytes—in particular, the mononuclear white blood corpuscles, which have been tightly packed together by the action of the centrifuge, and are ranged at the top of the red clot, leave their ranks and wander out into the adjacent regions of the white clot. The polynuclear leucocytes also are affected by eleutherotropic wandering. They come out from the hinder ranks of the leucocytic layer, and also from deeper down in the red clot, and wander free. In our observations we leave out of account all those leucocytes that have wandered outside the white clot. We regard them as having run to waste.

A further point which claims attention in connexion with emigration is the *nature of the emigrating leucocytes*.

Ordinary *eleutherotropic emigration* is predominantly mononuclear, this being probably accounted for by the fact that the white blood corpuscles which are ranged up along the line which divides the red from the white clot are almost all mononuclear. In *chemotactic emigration* we have either a differential emigration of polynuclear white corpuscles, or a mixed mononuclear and polynuclear emigration in which either the one or the other of these varieties of leucocytes may

predominate. In all such mixed emigrations the polynuclear, presumably because they are faster of foot, overtake the mononuclear leucocytes and pass on and occupy the more distal portion of the field of emigration.

Method of arriving at a Quantitative Expression respectively for "Compact" and "Dispersed" Emigration.

A quantitative expression for the emigration movement which takes place in a capillary tube can be arrived at in two ways. When we are dealing with a *compact* emigration (fig. 7, *B*)—that is, where the field

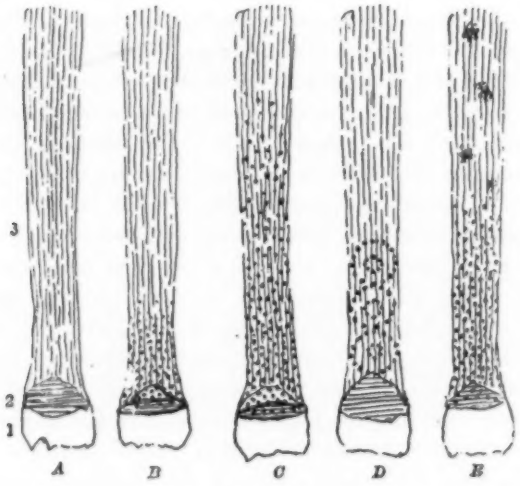

Fig. 7.

Clots from emigration tubes blown out and mounted. *A*, no emigration; *B*, compact emigration; *C*, dispersed emigration; *D*, method of dividing up the clot for enumeration; *E*, bacterial colonies coming up only in portion of clot which has not been reached by the emigrating leucocytes.

of emigration is quite closely packed with leucocytes—we have simply to measure the area of that field, or (and this answers the purpose perfectly well) the length of clot occupied by the emigration; and we may conveniently measure it in terms of microscopic fields. In such measurements we take off from the base-line furnished by the distal border of the cone of leucocytes which occupies the base of the white clot. This represents the original leucocytic layer converted, by the

contraction of the fibrin, into a cap covering the upper end of the red clot.

When, as will happen when a longer time has been allowed for the wandering out and dispersion of the leucocytes, we have before us a *dispersed emigration* (fig. 7, *C*), it will no longer suffice simply to measure the distance the leucocytes have travelled into the clot. It now becomes necessary to enumerate the emigrating cells. Employing first a low-power lens, we bring the upper edge of the cap of leucocytes to the extreme edge of our field of view. Then turning to our oil immersion, we bring this down upon the central portion of the low-power field, and make a count of all the leucocytes which lie within its purview—when necessary helping ourselves out in our count by introducing into the diaphragm of our eyepiece a cover-glass divided up by light rulings, made with a glass writing pencil. Having obtained in this way a value for the emigration in an arbitrarily selected portion of the first microscopic field, we go back to our low-power objective and move our specimen along until the objects on the extreme distal margin have been carried right across the field, and now lie just out of view on the other side. The further steps in the procedure are now simple repetition.

What are obtained by this method of enumeration are, of course, only arbitrary figures, and it will be realised that the comparative values arrived at will be strictly accurate only where we are employing clots of similar thickness.

Survey of the Data which the Method has already given.

We may now pass on to consider some of the data that the method has already given. White blood corpuscles will move out in any direction towards a chemotactic substance. They will, however, emigrate more freely downwards than horizontally, and more freely horizontally than upwards.

Anaerobic conditions are more favourable to emigration than aerobic conditions. Leucocytes will travel out farther in the direction of a chemotactic substance when we absorb the oxygen in the tube with caustic alkali and pyrogallic acid and seal, than when we leave the end of the tube open to the air.

Leucocytes emigrate more abundantly in tubes standing at a temperature of 40° C. than in tubes standing at 37° C. They do not emigrate at temperatures of 10° to 15° C.—the temperature which

prevailed on our laboratory bench. After exposure to temperatures of 0° C. for periods of half to one hour they emigrate apparently as freely as before.

Emigration apparently goes on unaffected in the presence of ether. It is abolished or suspended in an atmosphere of chloroform.

Physiological salt solution—brought into application either by traversing, or by superimposing it upon the clotted or unclotted blood—induces a very vigorous emigration of polynuclear white blood corpuscles. Weaker salt solutions induce a less vigorous emigration, and

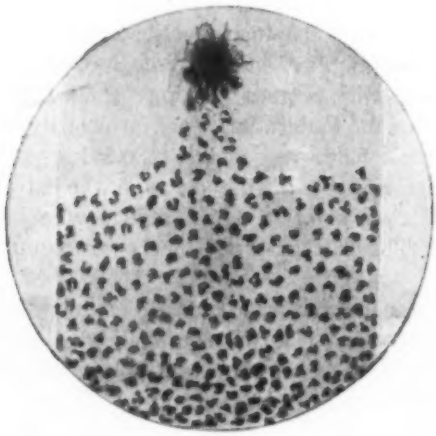

FIG. 8.

Extreme limit of emigration, showing phagocytes attacking streptococcus colony.

water again a less vigorous. Strong salt solutions—for example, 5 per cent. salt solutions—suppress emigration.

It will be appreciated in connexion with these and all findings obtained by this method that they do not tell us the effect of reagents acting in the specified dilutions directly upon leucocytes, but only the effect of these reagents operating from a distance. In other words, our experiments do not furnish information as to what would be the effect of bringing the chemical agents in the specified concentrations directly in relation with the capillary wall.

Bacterial suspensions which have been sterilised by heating evoke, according to the dilution in which they come into application, quite

different effects. The general rule applying to bacterial suspensions would seem to be as follows: Concentrated suspensions usually completely suppress emigration. Ten or hundred fold diluted, they evoke vigorous emigration. When we employ progressively higher dilutions we arrive in time at a point when the effect is exactly the same as that of the particular fluid which we are employing as a diluent.

Normal bloods tested with one and the same series of bacterial suspensions exhibit quite different degrees of chemotropic sensibility. Chemotropic sensibility, not alone to bacterial suspensions but also to

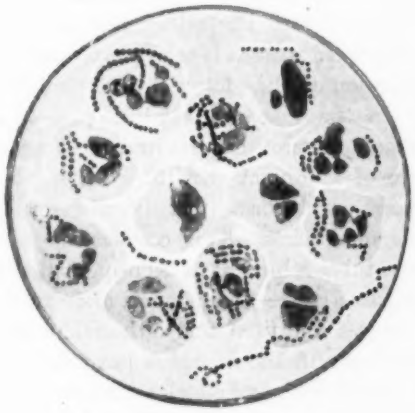

FIG. 9.

Phagocytosis of streptococci towards extreme limit of emigration.

physiological salt solution, is very strikingly modified in the case of patients suffering from bacterial infections. This also applies to persons inoculated with streptococcic vaccines. In five out of six men, inoculated with such a vaccine and examined both before and afterwards, the emigrating response to streptococcus was very strikingly increased subsequently to inoculation. In the case of one man it was diminished.

Results somewhat similar to those obtained with dead cultures are obtained with suspensions of living microbes (streptococci and gas-phlegmon bacilli), but here the prolonging of the incubation period may strikingly alter the situation.

What generally happens may be summed up as follows: When, by superimposing and centrifuging, a heavy sowing of microbes has been implanted into the unclotted blood, the colonies come up all along the white clot, and emigration into this is completely checked. Where only a moderate implantation of microbes has been made we have in different parts of the clot different results: Bacterial colonies develop freely in the distal area of the clot which is not invaded by emigration. In the intermediate region—that is, in the region where the microbes can grow out before the leucocytes arrive—one sees with the low-power objective areas specially crowded with leucocytes—these are in point of fact colonies which are being broken up and dispersed by invading leucocytes (fig. 8)—and with the oil immersion one sees that every leucocyte in these crowded masses is taking up microbes, and that there is also in all this region of the clot plentiful phagocytosis of scattered microbes (fig. 9). In the base of the white clot—that is, in the area where emigration has occurred earliest and most vigorously—one finds absolutely no trace of microbial growth.

The appearances which have just been described correspond, of course, to a period of conflict. This conflict is generally at its most interesting phase in tubes which have been incubated from three to six hours. When we come later—for instance, after twelve or more hours—the conflict is over. We then find either that the white corpuscles are masters of the field and the microbes have disappeared, or else that the microbes have invaded the whole clot, and that this crumbles away as soon as it is blown out into water. There can be little doubt that the crumbling away of the clot, and the overrunning of the blood with microbes, are due to the digestion of the fibrin, and to the corruption of the blood fluids by trypsin set free from the disintegrated leucocytes.

Experiments such as these just outlined, in which living microbes are brought into application on blood, provide, in point of fact, a valuable test method. They tell us the resultant of the *chemotropic sensibility* of the leucocytes, the *opsonic power* of the blood fluids, the *digestive capacity* of those phagocytes which come into action, and of the *antitryptic* and, where such comes into account, the *bactericidal* power of the blood fluids. We are, in fact, furnished with something like a complete evaluation of the antibacterial powers of the blood.[1]

[1] It will be observed in connexion with tests thus conducted with centrifuged blood that, if we leave out of regard the centrifugalisation, they are in all essentials the same as the *phagocyto-bactericidal* tests with freshly drawn uncentrifuged blood which I have already described ("Vaccines and Drugs in Pneumonia," Constable, 1914).

There is still one element left out of account. The method here in question does not tell us anything as to whether or no there are bacterial poisons in solution in the blood fluids of the infected man. But this is a question which can be separately investigated. I have tried to find the answer by traversing normal bloods with serums derived from patients suffering from septicæmic infections. And I have by this procedure obtained in a series of cases what appeared to be a definitely chemotropic emigration.

All that has been recounted above is, of course, only a very small beginning. But I think we may be confident that the method for the study of emigration which has here been proposed will resolve important problems in connexion with infection generally, and also—and this is what specially concerns us here—some of the problems in connexion with wound infections which are now urgently pressing for a solution.

In the matter of general problems of infection it would, I think, be possible, by implanting bacteria into blood in combination with chemical agents which would respectively promote and hinder emigration, to resolve for each particular bacterial infection the question as to whether it is the leucocytes or the blood fluids which come most into consideration as destructive agencies. That problem once resolved, we should know whether we ought, in the infection in question, to direct our chief efforts to increasing the efficacy of the blood fluids or to modifying the chemotropic sensibility of the leucocytes and encouraging emigration.

Again it looks as if it might be possible by very simple experiments to resolve the problem as to why in gonorrhœa, and also in other surface infections, the purulent discharge is suddenly arrested when the microbes succeed in invading the blood-stream, or establishing themselves in an articulation or elsewhere in the interior of the body. It would seem possible (for something of this kind would seem to occur in septicæmias supervening on wound infections) that we may be dealing here with a paralysis of the emigrating powers of the leucocytes. Or, again, it is possible that in these cases emigration may be simply suspended by a redistribution of the chemotactic forces. In other words, the cessation of the external discharge may simply mean that there is now in the blood a bacterial poison; and that this chemotactic element, acting upon the leucocytes as a *vis a tergo*, counterbalances the *vis a fronte* of the chemotactic substances produced by the bacteria on the external surfaces.

In connexion with the particular problems of wound infections we may hope at no distant date to come into possession of information

which will enable us to activate or restrain, according as the one or the other may approve itself the better policy, the emigration of leucocytes into the wound. And we may hope also to determine in connexion with every antiseptic or other solution which is brought into application in a wound, whether it promotes or hinders emigration.

Finally, let me point out—for everything that concerns bacterial vaccines concerns the treatment of wound infections—that experiments on emigration will almost certainly resolve a number of important outstanding questions in connexion with vaccines. They ought very easily to resolve the question as to what is the best excipient for a vaccine—whether a menstruum which would restrain emigration, or one like physiological salt solution which would call forth a vigorous emigrating response at the point of injection. And lastly—and this would be one of the most important applications of observations on emigration—we ought to be able to determine what is, in the case of each bacterial vaccine, the dose which will induce the earliest possible and the most effective determination of phagocytes to the focus or foci of infection.

We may, with such new knowledge as we have acquired from the experimental methods I have described, now revert to the consideration of those three ways of combating wound infections enumerated earlier in this discourse. It will be remembered that these were: *Treatment by antiseptics*, *treatment by physiological methods*, and *vaccine therapy*. We will take them one by one.

Treatment by Antiseptics.

If we adopted the Socratic method, and were to inquire of the first man we found engaged in washing out a wound what were the grounds for his confidence in the utility of the procedure, he would probably make some such answer as the following: "I know that the antiseptics which I am bringing into application are agents which directly kill and inhibit the growth of microbes. There is no other agency known which would be competent to do the bactericidal work that these antiseptics do in the wound. And, again, it is everybody's knowledge that Lister, by introducing his antiseptic treatment, extirpated those septic infections of wounds which before the advent of his method devastated the surgical wards of every hospital."

And if we were to push our question further, and ask of the surgeon to what particular end and object his procedures were directed—whether it was the sterilisation of the wound; or the killing off of

a large proportion of the microbes or the imposition of a check upon the survivors; and if we were further to ask, whether the particular antiseptic in the particular strength in which he was employing it could be relied upon to achieve the end in view; we should probably be told that, supposing that the antiseptic did not completely sterilise the wound, it would inevitably kill a large number of microbes; and it would probably also inhibit the growth of any survivors. And, inasmuch as one or other of these objects would be sure to be achieved, there could be no question but that advantage would accrue to the patient.

We should, in short, get an answer which proceeded upon at least one erroneous premiss, and which betrayed loose and inconsequent thinking, and a reluctance to come to close quarters with the question. But though the reasonings of the larger part of humanity are neither better nor worse than this, it is not for that less necessary to take them into very serious account, and to do our best to correct them when they mislead.

Let us begin, since Lister is the fount and origin of all antiseptic treatment, with what relates to his work. Lister's name is associated with two discoveries. The *first* of these is the discovery that we can, by an *anticipative prophylactic application*, hold off microbes from surgical wounds, and so avoid wound infections. The *second* is that in cases of compound fracture where the wound is already infected we can still, by what I may perhaps call a *retrospective prophylactic application of antiseptics*, stave off the wound infection. The first of these is a discovery of absolutely universal application, and it will carry the name of Lister down to remotest posterity. The second discovery has reference only to a particular kind of traumatic wound, and shows that prophylactic applications of antiseptics can be usefully employed also in connexion with some wounds which are already infected.

It is clear that neither of these discoveries finds any direct application either in connexion with prophylaxis or the treatment of the infections which occur in projectile wounds.

What it is necessary to say on the possibility of preventing septic infection by sterilising projectile wounds can be said in a very few words. The principle that microbes can be held off from wounds by an antecedent employment of antiseptics has no application to projectile wounds, for these are infected before they are seen by the surgeon. Nor, again, is the Listerian discovery that prophylactic applications of antiseptics in the ordinary compound fractures of civil life can

stave off wound infection related to conditions such as obtain in projectile wounds. Retrospective, or, as we may also call them, *ex post facto* prophylactic applications of antiseptics will give good results only when the microbes are accessible. In the case of the ordinary compound fracture of civil life this is the case. For here the microbes lie exposed on the external surface of the bone which has been thrust through the skin. The contrary holds for projectile wounds. Here the microbes are inaccessible. They have been carried down deep into the tissues, and lie on the inner face of a torn and ragged track; and that track is blocked by blood-clot and hernia of muscle.

It is clear that the utmost that prophylactic applications of an antiseptic could under such conditions achieve would be an incomplete sterilisation. And an incomplete sterilisation would leave us with a wound infection, and in a few days with as bad an infection as before. Coming now to actually subsisting wound infections, we see that exactly the same thing would apply. We are not entitled to infer from the fact that the method of Lister is within its limitations an effective method of prophylaxis that it is also an effective method of treatment. That is clearly a question which must be determined as an independent issue.

When we approach the question in this way we see that the first point which has to be determined is: What particular concentration of each particular antiseptic will, when applied to the wound, exert there a bactericidal action on the microbes? In connexion with this we must beware of the fallacy of taking the figures for an antiseptic acting on microbes in watery suspension and seeing in these an all-round formula of efficacy for that particular antiseptic.

A formula of efficacy of this kind might, of course, find a useful application where the sterilisation of skin surfaces and instruments was concerned. For here the antiseptic comes into operation on exposed microbes in full strength. In practically every other case the conditions would be entirely different. The antiseptic would have to come into operation in a medium which quenches its antibacterial action.

I have recently, in dealing with internal medication by antiseptics in pneumonia, brought forward[1] an array of experiments which show that the quenching of the anti-bacterial power of antiseptics by the medium in which these come into application, is the essentially important factor to be considered in connexion with their therapeutic use. In particular

[1] "Drugs and Vaccines in Pneumonia," Constable, 1914.

I have shown in connexion with drugs like creosote and guaiacol, that doses which would almost certainly be lethal would have to be administered before these could come into operation in blood.

The same sort of thing holds true of pus. But here the situation will be different in two respects. It will be different in respect that, as compared with serum, pus exerts a greater quenching effect upon antiseptics. It is, if I may put it so, more *antisepticotropic*. This will prevent us taking the antisepticotropic values for the serum and applying them to the pus in the wound. Again, the conditions under which an antiseptic comes into application in a wound will contrast with those which come into application in internal medication. In connexion with internal medication we have to take into consideration the quenching influence which would be exerted by the totality of blood. In applying antiseptics to the wound it lies with us to make the conditions much more favourable to the antiseptic. We can, if it is a question of washing out a wound with antiseptics, make the relation of antiseptics to pus anything that we please. And where it is a question of leaving an antiseptic behind in the wound for the purpose of inhibiting growth, we can also, within limits, lay down our own conditions, and make provisions which will prevent the conditions becoming too unfavourable to the antiseptic.

If there are, in the published literature on antiseptics, any papers dealing with the investigation of the efficacy of antiseptics from this point of view, they have escaped my observation. I have accordingly in conjunction with my fellow-workers, Dr. W. Parry-Morgan and Dr. A. Fleming, set to work to supply the missing data. To find out what concentrations of antiseptic ought to be brought into operation in washing out a wound we took nine volumes of antiseptic to one of pus. To determine what inhibitory effect would be exerted by an antiseptic left behind in a wound we took one portion of the antiseptic to—as the case might be—two or four volumes of pus. It will be seen that by this plan of operation we conduct our experiments directly on the microbes and pus furnished by the wound; in other words, instead of dealing with any abstract question, we deal with the concrete question which presents itself in the particular wound infection which happens to lie before us.

The general results obtained in this investigation will be separately set forth. At the moment it will suffice to call attention to the fact that when employing nine volumes of the antiseptic solution to one of pus from the infected wound, and leaving the antiseptic in application for ten

minutes, a strength of 1 in 40 of carbolic acid, and strengths of 1 in 400 of biniodide of mercury, and 1 in 500 of tincture of iodine all failed to sterilise. Again, in experiments on inhibition, one volume of a 1 in 30 dilution of lysol, and 1 in 400 of tincture of iodine, and 1 in 200 solution of biniodide of mercury did not avail to prevent bacterial growth in four volumes of pus. But I must not delay over the question as to what will with a particular antiseptic be the particular concentration required for the attainment of a particular antibacterial effect. Let us revert to our task of trying to bring the whole question of the employment of antiseptics in wounds into some sort of proper perspective. It will help us to do this if we consider the following questions:—

(1) *Is there any reasonable prospect of sterilising the wound by an application of antiseptics?*

So far as the pus which is brought into intimate contact with the antiseptic is concerned, it would probably be possible to sterilise this by methods which will elsewhere be explained. But we have in the wound not only pus which can be reached by our antiseptic washings but also pus which is locked up out of reach in blind alleys and pockets. And, again, we have in the infected wound not only a microbic infection of discharges, but also a microbic infection of the granulation tissue. And assuredly the really formidable difficulty in connexion with the sterilisation of the wound is that of getting sufficient penetrating power to deal with these sheltered microbes.

Now the ordinary antiseptics which we employ in wounds have as good as no penetrative power, and, though it is possible to undertake comparative experiments, and as an interesting academic exercise to determine for a series of antiseptics how far their antibacterial influence may extend in agar or any other artificial medium, academic exercises like this ought not to divert our attention from the fact that there is not, among all the competing antiseptics, one which can penetrate into and sterilise the walls of an infected wound. In fact, if it were ever to come about that an antiseptic sterilised heavily infected wounds, that would be a matter to announce in all the evening and morning newspapers. Nor is it matter for surprise that antiseptics should not be able to penetrate into granulation tissue. Let us call to mind the fact that this is composed of continuous layers of cells; that the cell wall is a quasi-impenetrable membrane; further, that we have in the granulation tissue a well-developed system of capillaries, capable of absorbing and carrying away any antiseptic that might penetrate: and, lastly,

that we have also in the granulation tissue an outflowing lymph current. Having realised the inefficacy of antiseptics for the purpose of sterilising an infected wound, let us now pass to the next question. It may be formulated thus :—

(2) *Is there, in point of fact, any ground for the confident belief that a reduction in the number of microbes, such as would be obtained by washing out the wound with antiseptics, must carry advantage to the patient?*

We have realised that it is a firmly established conviction that every procedure which leaves behind in the wound fewer microbes would, like a smaller sowing of seed, sensibly reduce the ultimate crop, and so sensibly advantage the patient. The bacteriologist does not see that this is a matter of course. He thinks not only of the sowing, but of the soil. He reflects that when we are dealing with a microbe which reproduces itself rapidly on a particular medium—let us say the typhoid bacillus in peptone broth—the lightness or heaviness of the sowing would after the lapse of a comparatively short time hardly come into account. Again, in the case of a microbe which multiplied itself very slowly in a particular medium the sowing would, unless the incubation period were indefinitely extended, make very little difference to the result. Finally, where a microbe grows very slowly on a particular medium, but very rapidly as soon as this undergoes transformation, the population of microbes found in the culture would clearly depend less on the number implanted than on the time taken to convert the nutrient substratum from a bad into a good cultivation medium. It is, in the light of what has gone before, quite easy to see the application of this to the wound. Whether few or many serophytic microbes are left behind in the wound will make comparatively little difference to the number found in the uncorrupted lymph. For serophytes will multiply rapidly unless constantly kept down by phagocytosis. Again, in the same way, whether few or many sero-saprophytes are left behind would not make much difference to the number found in the uncorrupted discharge. For sero-saprophytes grow very badly on this medium. But the factor which will readily exercise a determining influence on the result will be the rate at which the lymph becomes corrupted. And the practical conclusion emerges that what is really difficult in dealing with an infected wound is not to thin out the microbes, but afterwards to keep down their numbers. We are here carried along by our train of thought

to the "dressing of the wound"; and in connexion with this we may put the following question to ourselves:—

(3) *What conclusions can be drawn from the fact that frequent re-dressings are indispensable in connexion with the treatment of infected wounds by antiseptics?*

This is one of those questions of which we realise the fundamental significance as soon as they formulate themselves in the mind. When our treatment has miscarried, and the wound has filled up again with pus, and this has become tryptic and has begun to digest the granulations and skin surfaces with which it comes into contact, and when bacterial poisons are being absorbed into the system, we are compelled to re-dress the wound. In other words, when we have been falling away we have to try to get back to the position which was reached at the previous dressing. And let us in this connexion note that it is one thing to be able when unsuccessful to fall back upon dressing, and to make of this a point of departure for trying a new way; and quite another thing to accept dressing as a necessary and inevitable element in our programme of treatment, and then not even to propose to make it a point of departure for a new therapeutic effort, but calmly to contemplate an everlastingly repeated setting out into a blind alley, and an everlastingly repeated return to our point from which we started. If grace had been given us to see things with unsophisticated vision, it would be clear to us that to make constant re-dressing an integral and indispensable element in our programme of treatment is really as much of a confession of failure in the case of an infected wound as in a surgical operation. It is equivalent to saying that our method of treatment leaves the wound in a condition which makes healing impossible. And, finally, this leads on directly to the question:—

(4) *How are we, in view of all the above, to account for confidence in the utility of the antiseptic method of treatment?*

We may here begin by emphasising that in all probability the antiseptic method, considered as a method for preventing the importation of foreign germs into the wound, has deserved everything in the way of praise that may have been said of it. For it is no doubt owing to the fact that antiseptic solutions have everywhere been employed for washing out the wounds, that there have not developed in the military hospitals in this war any of those graver forms of infection which in pre-Listerian days never failed to put in an appearance. When, how-

ever, we pass from prophylaxis to treatment, and from the consideration of the effects in connexion with the patients, taken as an aggregate, to the effects which manifest themselves in the individual who is under treatment, it is then that we come face to face with the problem as to how it has come about that the obvious non-success of the antiseptic treatment is not generally appreciated. It seems to me that this also must be put down to sophisticated vision and to the effects of education. We must remember that the practitioner of to-day has been educated to expect to find, within a few hours after washing out an infected wound with antiseptic, as much pus and as many microbes as when he last came to dress it.

We now pass to

Treatment by Physiological Methods.

We shall do well to begin by putting quite away from us the current preconception that to abandon antiseptics would be equivalent to abandoning the programme of killing microbes in the wound. A moment's reflection will show that Nature has from the very beginning of things been bringing to bear her own antibacterial agents on infecting microbes; and that we have in antiseptics merely a recent substitute for these. Moreover, the surgeon, in treating wounds, has all along, though not with conscious aim, been bringing the antibacterial agencies of the body to bear on the infecting microbes.

In treating a wound infection by physiological methods we have therefore only to follow the surgeon's lead. But we may hope, as we go along, to improve upon his methods. For we shall fix our attention on the guiding principle which he has missed.

The chief points which the surgeon has insisted upon in connexion with the treatment of infected wounds and tissues are the following: Where there is an abscess sac or a closed cavity containing pus, this must be laid open, and an outlet for the discharge must be provided—if possible in the most dependent part. Where an infection has spread diffusely in the tissues, free incisions must be made; and where these incisions pass through infiltrated tissues they must be carried from sound skin to sound skin, and all the way down to the healthy structures underneath, and here hot fomentations should afterwards be applied. Lastly—and this is one of the teachings of the present war—when amputating through infected tissues unrestricted drainage must be provided: either by leaving the wound unsutured, or (in cases of

gas phlegmon) by reverting to the mediæval method reintroduced by Fitzmaurice Kelly, of cutting the limb squarely across, and dispensing entirely with flaps.[1]

Let me now try to show you that all these procedures—and it will not be necessary to consider them all in detail—will in the ordinary case bring the antibacterial agencies of the body into play. And let me further try to show you that when they fail to do this satisfactorily, they never, even when they accomplish all that the surgeon asks, do any effective good in combating the infection.

I shall begin by considering the *rationale* of opening up the abscess sac. The popular explanation accounts for the utility of this procedure by telling us that it provides issue for the infected discharges. But that is quite inadequate. For not only does the operation provide issue for the infected discharges, but when it succeeds it brings about the destruction of the microbes which are embedded in the walls of the abscess sac. In reality it alters the whole situation. In the unopened abscess the antibacterial agencies of the body are overborne by the mass effect of the infecting microbes. The white blood corpuscles in the abscess sac are paralysed, or killed; and all the antibacterial power of the lymph has gone. In the abscess that has been laid open and emptied, the infected bacteria are overborne by the mass effect exerted by the antibacterial agencies of the body. Fresh antibacterial lymph is streaming in through the walls; and phagocytically active leucocytes are emigrating into the empty cavity. But for all that the infecting bacteria are overborne, the infection is not necessarily extinguished. The laying open of the abscess does not always put everything right. The mechanical conditions may leave much to be desired. It may be necessary to obtain a larger outpouring of lymph to wash the embedded bacteria out of the walls of the wound, and to prevent them accumulating in the abscess cavity and effluent channel. Again, the antibacterial agencies of the body may require to be brought into more effective operation. It may be desirable to bring to bear on the microbes both a greater volume of antibacterial lymph and a larger force of phagocytes; or it may be proper to repress the emigration of leucocytes so as to prevent any breaking down of these in the wound.

Now the supplementary surgical procedures which were enumerated above, all contribute, more or less effectively, to the accomplishment of one or other of these ends.

[1] *Lancet*, January 2, 1915, p. 15.

Drainage-tubes are devices for preventing the accumulation of infected discharges. But they do not really keep down bacterial growth in the walls of the abscess cavity. There ought to flow out from a wound not a pus composed of disintegrated leucocytes and microbes, but a lymph which is inimical to microbes, and favourable to phagocytic activity; and things do not begin to clear up in a wound till its effluent runs clear.

Free incisions carried down into infiltrated tissues are intended to furnish an ample outlet. But in reality the dimensions of the outlet do not necessarily correspond to the superficial area of the incisions. In point of fact the effective outlet will in infiltrated tissues correspond only to a small section of that area. For the lymph spaces are blocked with leucocytes and fibrinous exudation. And there will, moreover, ooze out from the cut surfaces a highly coagulable lymph, which very quickly seals up any open pores.

Hot fomentations, in addition to macerating and bringing away the inflammatory exudate, will induce active hyperæmia, and so increase the outflow of lymph.

Leaving operation wounds unsutured and dispensing with flaps will, as already explained, give unrestricted drainage—so far at least as the mechanical conditions are concerned.

We have now arrived at some sort of a general idea as to what would be embraced under the term "Treatment by Physiological Methods," and we have realised that the empirical procedures of the surgeon furnish us with something to work with and improve upon.

It will be taking a first step to the improvement of these methods if we draw up for ourselves a complete list of desiderata. We shall, in setting these out, have to bring them into relation with the actual types of wound infection which come up for treatment.

In reality our infected wounds conform, nearly all of them, to one or other of two types: In the *first* type we have an infection of either the unclothed internal surface of the wound, or of the granulation tissue lining it. Examples of this type of infection are furnished (*a*) by recent projectile wounds whose walls are implanted with microbes; (*b*) by suppurating cavities which have just been opened up and evacuated; and (*c*) by old-standing suppurating wounds which have just been washed out and left clean. In our *second* type of wound we have an infection in a dry and infiltrated wall of an infected cavity and in the tissues contiguous to this.

In the former type of wound infection it would be a desideratum

to wash the infecting microbes out of the walls of the wound by means of a powerful outgoing current of lymph; and it would be desirable in connexion with this lymph that it should carry in with it into the infected cavity whatever force of phagocytes might be required; that it should furnish a favourable medium for, and directly assist, phagocytosis; that it should repress bacterial growth; and that it should not suffer any sensible diminution of antitryptic power if, after ineffective phagocytosis, a certain number of leucocytes broke down in it.

In the second type of infection, while everything that applies to the first type would apply, it would probably be desirable, as special measures, to repress further emigration of leucocytes, and to render the lymph incoagulable so as to prevent any stanching of the lymph outflow.

For the complete realisation of these desiderata we should require to have at disposal an agency for powerfully increasing the outflow of lymph. (I propose almost immediately to show that we have this at disposal.) Further, it would probably be necessary to have at disposal—but till further research has been carried out it is impossible to speak with certainty on this subject—means for promoting and repressing emigration. And lastly, it would almost certainly be necessary to be in a position to increase at need not only the antibacterial power of the lymph with respect to the infecting microbes, but also its general power of repressing the growth of sero-saprophytes. This however, will come up for consideration in connexion with treatment by vaccine therapy.

As just announced, I pass now to consider what agents we have at disposal for increasing the outflow of lymph. In this connexion we have already seen that the lymph flow from the wound can be increased by the application of hot fomentations. It can be increased also by introducing ether into the wound—the ether, like the hot fomentations, no doubt acting by inducing active hyperæmia.

But I think that better than either of these, because it is more continuous in its action, and because it renders the lymph incoagulable, and also perhaps because it represses emigration, is the lymphagogic application which I have been recommending now these many years back. This consists of a 5 per cent. solution of common salt, mixed with $\frac{1}{2}$ per cent. of sodium citrate. This brings into play osmotic forces, and "draws" the lymph out of the walls of the wound by a *vis a fronte*. The sodium citrate is added with a view to decalcifying the outflowing lymph and rendering it incoagulable.

I may perhaps be allowed to say with regard to this lymphagogic solution—or, rather, with regard to the simple 5 per cent. salt solution, which I find works in most cases equally well—that it has in this war proved itself pre-eminently useful. When brought into action upon a dry and infiltrated wound, or a wound that is foul and covered with slough, it resolves the induration, brings back moisture to the surfaces, and cleans up the wound in a way that no other agent does. Applied in gaseous gangrene in the form of a wet dressing to incisions which have been carried down into infected tissues it causes lymph to pour out of the wounds, and arrests the spread of the infection. And, again, applied in gaseous gangrene to an amputated stump in cases where it has been necessary to leave infected tissues behind, it reverses the lymph stream and draws out the infected lymph—saving life in almost desperate conditions.

What would be the proper culmination and end to the treatment of wound infections by physiological methods?

We have now arrived at a point when it will be proper to keep our eyes somewhat less closely upon the ground, and to ask ourselves what kind of a coping-stone is to be placed upon our edifice of physiological treatment. For it is clearly unthinkable in connexion with such treatment carried out on scientific lines that it should lead to nothing better than to that everlasting dressing and re-dressing of the wound which all antiseptic treatment seems to consist of. I am convinced that, when once we shall have learned exactly how to regulate the outflow of lymph, and to control emigration and phagocytosis, it will be practical policy to make an end, once and for all, to a wound infection, and to close up the wound.

Even as we stand at present that seems to me to be to some extent a realisable ideal. While it would lead too far to follow up this question in detail, it will, perhaps, not be amiss to direct attention to the following points:—

It will always and ever be impossible to sterilise a wound within the space of a few minutes. To wash out microbes from the granulation tissue will always take time. And we shall always have to allow time for the leucocyte to find the microbe; and for phagocytosis; and for the digestion of the microbe in the interior of the phagocyte. And again, and above all, we shall always have to allow a very large margin of time for the miscarrying of lymph lavage, emigration, phagocytosis, and the intracellular destruction of the microbes, and for the necessary going back over all these processes.

In view of this it will be clear that when we embark upon physiological treatment we ought to carry it out unremittingly. And our treatment will perhaps best take the form of continuous irrigation or continuous baths.

When by these means we think we have rendered our wound sterile, or nearly sterile, we must, in closing up the wound, or in giving it an opportunity of healing up under a scab, always proceed by the method of trial and error and provide for the possibility of the microbes again assuming the upper hand.

Treatment by Vaccine Therapy.

I emphasised at the outset of this discourse that treatment by vaccine therapy could take rank only as ancillary to treatment by physiological methods. In *treatment by physiological methods* we take the antibacterial agencies of the patient just as they are, and do our best to bring them into more effective application on the infective microbes. In *vaccine therapy* we seek to reinforce those agencies. We endeavour to increase the bacteriotropic power of the blood, and to modify the chemiotropic sensibility of the leucocytes. And, now that we have come to appreciate its importance, we should seek to increase also the antitryptic power of the blood fluids.

Let us try to see how the case for vaccines and vaccine-therapy stands, keeping always before us the great practical issue as to how much clinical benefit can in the particular case be secured for the patient, and arranging, for the purposes of our survey, the manifold applications of vaccines under six subheadings.

(1) *Prophylactic Employment of Vaccines.*—This is not only from the theoretical point of view the best of all methods of employing vaccines, but it is also the method which gives, in practice, the maximum of advantage. We have only to look to the results obtained by prophylactic vaccination against small-pox, cholera, plague, and typhoid fever.

(2) *Employment of Vaccines in the Treatment of Localised Bacterial Inroads.*—Next to prophylactic inoculations, this gives the best results. And the results, in respect of their being almost immediately manifest to the eye, are even more dramatic than those of any preventive inoculation. Perhaps the most rapid and convincing results are those obtained by small doses of streptococcic vaccine in lymphangitis and erysipelas; by staphylococcic vaccine in furunculosis, when the boil is

just beginning to develop; and by minimal doses of tuberculin in phlyctenular affections of the conjunctiva.

(3) *Employment of Vaccines in dealing with Unopened Abscesses and other Localised Infections where the Microbes cannot be reached from the Blood-stream.*—Vaccines are here, so far as appears to clinical inspection, quite inoperative.

(4) *Employment of Vaccines in the Treatment of Localised Infections associated with heavy Auto-inoculations.*—The scientific application of vaccines in these cases is extremely difficult and laborious, and the results which are obtained—and those obtained in the treatment of developed phthisis by tuberculin supply a good example—are not very convincing.

(5) *Employment of Vaccines in the Treatment of Undrained Wounds infected by Sero-saprophytes.*—There is not yet a sufficient body of experience to decide the question as to whether benefit can be obtained from vaccines in these cases. The question will be further discussed below in connexion with the wound infections of the war.

(6) *Employment of Vaccines in the Treatment of Septicæmic Infections, and, in particular, Streptococcic Septicæmias.*—Up to the present —except perhaps in certain series of experiments relating to typhoid fever—vaccines have, on the whole, given very disappointing results. But it will be obvious on consideration, that as we advance through the whole series of applications—from prophylactic application to the employment of vaccines in septicæmias—the conditions are becoming progressively more difficult; so that success in treatment of septicæmias, if it is ever attained, will be the very final achievement of vaccine therapy.

We have now prepared the ground for considering what has been obtained by the use of vaccines in the treatment of wound infections in this war.

I have, in connexion with this, heard the opinion of a very distinguished French surgeon—pronounced after watching the effect of vaccines upon, I should think, undrained wounds and septicæmic infections—that they had never done any good. I shall, by my general survey above, at least have put you on your guard against generalising from one class of cases to all other cases. Let us now take each class of case separately, and ask ourselves whether, in this, vaccines have rendered any service. I think we shall then see that things work out everywhere in accordance with scientific law.

(1) *Prophylactic Inoculations of "Antisepsis Vaccines."*—If prophylactic inoculations of this kind have not been undertaken in our army,

it has not been because a supply of antisepsis vaccines has not been at hand, but because the idea of undertaking such inoculations has not appealed to the individual medical officers who have given first aid to the wounded. And if any prophylactic inoculations have been undertaken, this can have been only on a very small scale; and the fact has not transpired. To be considered therefore here is only the question as to what we should on a priori grounds be justified in expecting from prophylactic inoculations against wound infections, undertaken upon the wounded. The answer is, I think, not doubtful. We might justifiably hope, in a proportion of cases, to sterilise the upper reaches of the wound which would be less heavily implanted; and perhaps in isolated cases—those in which we have a comparatively light sowing of microbes—to sterilise the whole wound. Moreover, if we could employ vaccines in combination with *physiological drainage* (I mean, by that, free outpouring of lymph obtained by the use of a lymphagogic solution) we might, I think, hope to stave off infection in a fairly large proportion of cases. But—and I have already, though perhaps not emphatically enough, drawn your attention to this in connexion with prophylactic applications of antiseptics—it will, when we set out to sterilise a wound, nearly always be a question of achieving either all we want or nothing. To leave behind, especially in the upper reaches of a wound, a few microbes, which immediately set to work and multiply, amounts, from the point of view of the future of the wound, to exactly the same as leaving behind alive the whole original population. If one really intends a war of extermination there must be no remissions; and if our first effort with vaccines and physiological drainage fails, we must immediately follow up with further efforts.

(2) *Employment of "Antisepsis Vaccines" in Cases where the Microbes make an Irruption into the neighbouring Tissues.*—In connexion with projectile wounds it is not very uncommon to see the infecting microbes breaking bounds, and making an irruption into the neighbouring tissues. This will occur either in a wound which has not been laid open, or where the lymph flow has stanched, and the microbes have been imprisoned in an infiltrated wall. The bacterial irruption may follow the course of the lymphatics as a lymphangitis; or it may take the form of an erysipelas or cellulitis. In these forms of infection occurring in connexion with projectile wounds, vaccines give exactly the same dramatic effects as in the small wounds of civil life—the only difference being that, when the irruption has been beaten back, we have in the case of projectile wounds still the original focus of

infection to deal with; and have, unless we improve the condition of the wound, always to be upon our guard against a renewal of the irruption.

(3) *Employment of "Antisepsis Vaccines" in connexion with well-drained Wounds.*—When we have in a wound quite unobstructed mechanical drainage—such, for instance, as is proved by amputation without flaps—we have, from the point of view of the immunologist, conditions exactly parallel to those which obtain when microbes make a first irruption into healthy tissues. In other words, we have here—and probably also where we have good physiological drainage—brought to bear upon the microbes an ample force of phagocytes in conjunction, it may be, with a rapid percolating or outflowing stream of lymph. As a consequence, vaccines give in these cases results which are so strikingly favourable as to arrest the attention of every beholder.

(4) *Employment of "Antisepsis Vaccines" in imperfectly drained Wounds.*—An overwhelming proportion of projectile wounds which are under treatment in hospital would, regarded from the point of view of the mechanical conditions, come into the category of imperfectly drained wounds. And this is as it must be. The conservation of the wounded limb is clearly the first object of the surgeon; and the treatment of the bacterial infection is quite subordinate. For example, no one could ask that a leg which had been perforated by a bullet should be cut free from all its attachments to give better drainage to the infected track.

Now it might be legitimate to say that these undrained wounds were analogous to the unopened abscesses referred to above, were it not that this comparison would do much less than justice to the difficulties which confront the immunisator in the wound where pus accumulates. Not only have we in the recesses and backwaters of such a wound conditions which make it impossible for the antibacterial agencies of the body to establish by their mass effect a position of superiority over the microbes; but we have in the corrupted discharges and the multiform bacterial growth which they harbour, obstacles to successful immunisation such as are never encountered in an unopened abscess cavity. It is therefore not to be expected that we should in these cases see—and in point of fact we do not see—after the exhibition of vaccines any diminution in the pus which pours from the wound.

None the less we shall do well carefully to consider certain questions in connexion with the employment of vaccines in the treatment of imperfectly drained wounds. It is clearly a matter for consideration

whether — despite the fact that the output of pus from the wound is not diminished—there may not be some useful clinical result from the vaccines. It is quite likely that there is such an effect; and that it takes the form of a "nibbling" at the infection in those parts of the wound lying above the ground level of the pus; a better entrenchment against the microbes; and, behind this, a massing of reserves which would be brought to bear if the microbes were to irrupt into the surrounding tissues. In short, it is not unreasonable to think that the antisepsis vaccines might aid the surgeon in his conservative surgery, and might enable him to hold on longer when trying to save a limb.

Two further questions—questions which also cannot yet find answers—come up for consideration in this place. The one is the question whether it would not be possible in many cases to convert by physiological drainage an undrained into a drained wound, and then to obtain good results by the use of vaccines. The other is the question as to whether or no the bacteriotropic substances produced in response to antisepsis vaccines would come into operation upon sero-saprophytic microbes in corrupted discharges, and in lymph whose antitryptic power has been artificially diminished.

(5) *Employment of "Antisepsis Vaccines" in Septicæmias supervening on Wound Infections.*—On this question there is nothing that can be usefully said other than that until scientific knowledge has progressed much beyond where it is now, it might be well to act upon the suggestion made above with regard to the possible utility of antisepsis vaccines in staving off septicæmic infections.

We now at the end of our survey come to the summary. That summary would clearly be, that the results of the inoculation of "antisepsis vaccines" have conformed in everything to scientific expectation. Of the five possible applications of vaccine therapy, the *second* and the *third* have, according to anticipation, given strikingly favourable results. The *fourth* and the *fifth*—but perhaps certain reserves may be made in connexion with the *fourth*—have given, as anticipated, very unfavourable results. And that prophylactic employment of antisepsis vaccines, which has not yet been put to probation, would seem eminently deserving of an extended and careful trial, preferably in conjunction with physiological drainage.

EPILOGUE.

And now, except for a few concluding words, I have completed what I had to say. Up to this point we have considered only the scientific problems which confront us in wound infections. What we have now to consider is how this, and similar researches, and all that new clinical experience which has been won in this war, can be made useful to the wounded.

This is a question of setting up machinery for directing and co-ordinating the work of the medical officers engaged in the treatment of the sick and wounded. And, I take it, on a question of that kind the medical profession at home will have a voice, and, if unanimous, perhaps even have a deciding voice.

In order to enable you to judge what changes in the system would be required to give effect to the idea that medical officers should bring into application the latest lessons of experience and science, I will venture to remind you how the Medical Service of the Army is at present organised.

We have in the Army Medical Service, as it seems to me, three different and distinct services—a *Service of Administration*, *a Service of Hygiene and Sanitation*, and a *Service for the Treatment of the Sick and Wounded*.

The Service of Administration—and among the three services it comes easily first in order of importance—takes charge of the wounded man on the battlefield; conveys him first to the dressing station, field hospital, and clearing hospital which are ranged one behind the other at the front; thence transports him in an ambulance train to the hospitals at the base; afterwards embarks him in a hospital ship; and, at the end of his journey, provides him with hospital accommodation at home. The Service of Administration has further to see to the feeding, clothing, bedding, nursing, and medical treatment of the man in hospital, and in transit; has to look after all manner of surgical and medical stores and equipment—besides providing in a thousand other ways for the proper working of the hospitals and hospital camps.

The *Service of Sanitation* has to protect the Army against epidemic disease by attending to water supply, conservancy, and antityphoid inoculation. It has to keep a watchful eye on every case of infectious disease; to detect carriers; to equip, and man, the bacteriological laboratories required for this purpose; and to intervene in ways too numerous to mention to prevent the dissemination of infection.

The duties in connexion with the aforesaid services devolve almost exclusively upon the permanent officers of the Royal Army Medical Service. Their work, as every one at the seat of war knows, has been quite marvellously well done. And what stands already very high in the esteem of all the world needs no more words of praise from me.

There remains the *Service for the Treatment of the Sick and Wounded*. After supplying all the multifarious duties just enumerated, there are very few medical officers of the permanent staff of the Royal Army Medical Corps left over. Hence nearly the whole care of the sick and wounded has fallen to the civil practitioners enlisted for temporary service with the Royal Army Medical Corps. For this, if for no other reason, it must be the special concern of the civil profession to do all that in it lies to help the Medical Staff of the Army to employ to the best advantage the civil practitioners now serving as medical officers in military hospitals.

What has been done in the way of regulating the work of these new-joined medical officers has been to transplant practically unaltered into the military hospitals the organisation under which medical practitioners work in civil life and in peace.

The treatment of the sick and wounded is committed, as it is in private and hospital practice at home, into the hands of individual practitioners, there being assigned to each a certain number of patients, or a ward. And, just as at home, where each medical man is in practically independent charge of his cases, and is free to follow whatever treatment appeals to him, so is it in the military hospitals. And just as at home the free exercise of private judgment carries with it an exclusive responsibility, saving only in those cases where a consultant is called in to advise, so also is it in the military hospitals.

Now, I submit that this unchartered freedom can work for good only in conditions such as those which surround us at home. At home, the practitioner finds himself practically always upon ground with which he is familiar. The cases which he deals with in his practice are similar to those he has seen treated in hospital. And if he should find himself upon unfamiliar ground he will, before he need take action, have time to inform himself. Moreover, though new science filters in slowly, it does filter in. And, finally, when the medical practitioner at home makes a new experiment in treatment, he—and this is the all-important point—does learn what results. He can, therefore, profit from the teachings of experience.

Now, the conditions in military hospitals abroad are quite different

from these. The practitioner is there on quite unfamiliar ground. He has to confront unfamiliar problems—problems in connexion with projectile wounds and wound infections. He has to take immediate action. He has very little opportunity to find out what has happened in similar cases. And lastly—and you will see that upon this point everything pivots—he has very little opportunity of seeing the results of his work, and learning whether his treatment has been wrong or right. For the military hospitals in France, both at the front and also at the base, have now, through military necessity, become little more than clearing hospitals, from which cases, if at all fit to travel, are immediately sent upon their homeward journey.

There are thus lacking in the military hospitals in France all those provisos and safeguards which alone can make successful a system in which each medical man is a guide to himself. And carried out without those safeguards that system is unjust both to doctor and patient.

The doctor feels himself left in the lurch when he is not warned off from trying experiments in treatment which a hundred others have unsuccessfully tried. He fain looks for a lead where a successful treatment has been discovered. And, where there are a number of alternative treatments, he would be glad to see comparative experiments instituted to tell him which method is best. Nor is the doctor the only person interested. The patient, his relatives, and the whole nation would, once their thoughts were directed to the matter, feel that they had the vital interest in making the work of the medical officer as effective as possible.

If this is to be done it will, I believe, be necessary to make a fundamental change in the organisation of the Medical Service—to break away from the principle of free arbitrament in treatment for the Medical Officer, and to provide that all treatment shall be regulated by orders and instructions.

These are, as you see, very big issues. It is a question of a conflict between our cherished professional tradition that every medical man must be quite unfettered in his choice of treatment; and the very foundation principle of the Army, that every man shall work, not as he individually thinks best, but as part and parcel of a great machine.

The question as to which of these shall give way to the other must, of course, be decided by the balance of public advantage. And we cannot seriously doubt as to which side that balance inclines. We have only to consider what has been achieved in this war by antityphoid inoculation, and the preventive injection of antitetanus serum; and to

compare the brilliant results of these measures, enjoined as they are by direct instructions from headquarters, with the results which would have been obtained if their carrying out had been committed to the individual judgment of medical men who had not had before the war any opportunity of convincing themselves by personal experience of the utility of either antitetanus or antityphoid inoculation.

If now, as we see is the case, considerations of public utility commend the control of treatment of the sick and wounded by orders and regulations, let me in conclusion very briefly consider with you how under such a system there might be obtained a maximum of advantage with a minimum of disadvantage. I shall, of course, indicate only in very broad outlines what would seem to me to be the requirements.

I believe there would require to be a Professional Head to the Service for the Treatment of the Sick and Wounded. He would, of course, be subordinated to the Director-General, and his duties would be to bring up the work of the medical officers everywhere to the highest standard, and to co-ordinate their work from hospital to hospital.

It would further, I think, be necessary to have an Advising Committee who should be charged with the duty of synopsising the clinical experience won in the war; of finding out what results the various therapeutic procedures had given; and of drawing up on the basis of these inquiries general instructions and recommendations for the treatment of different categories of cases. On a Committee of this sort one would, of course, wish to see representatives of surgery, of medicine, of the various specialities, and of pathology and bacteriological science. But one would wish to see the membership restricted to those who were actually at work at the seat of war, and who were prepared to take full responsibility, and carefully to watch the working of the recommendations, and at any moment to revise them in the light of accumulating experience or further laboratory experiments.

Finally, one would wish to see attached to such a committee a Research Department for the resolution of all bacteriological questions arising in connexion with hygiene, surgery, and medicine. And I may perhaps be allowed, in connexion with this last, to point out that the Medical Research Committee of the National Insurance Act, under whom I have the honour to serve as Director of Bacteriological Researches, has, since the outbreak of the war, been placing not only large funds but a carefully selected corps of skilled workers at disposal for the prosecution of researches directly contributory to the better treatment of the wounded. It is for you to see that full advantage be taken of the results as they are obtained.